Science and Invention

IN PICTURES

THE BATTLE OF THE COLORS

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40 NON-TECHNICAL RADIO ARTICLES

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
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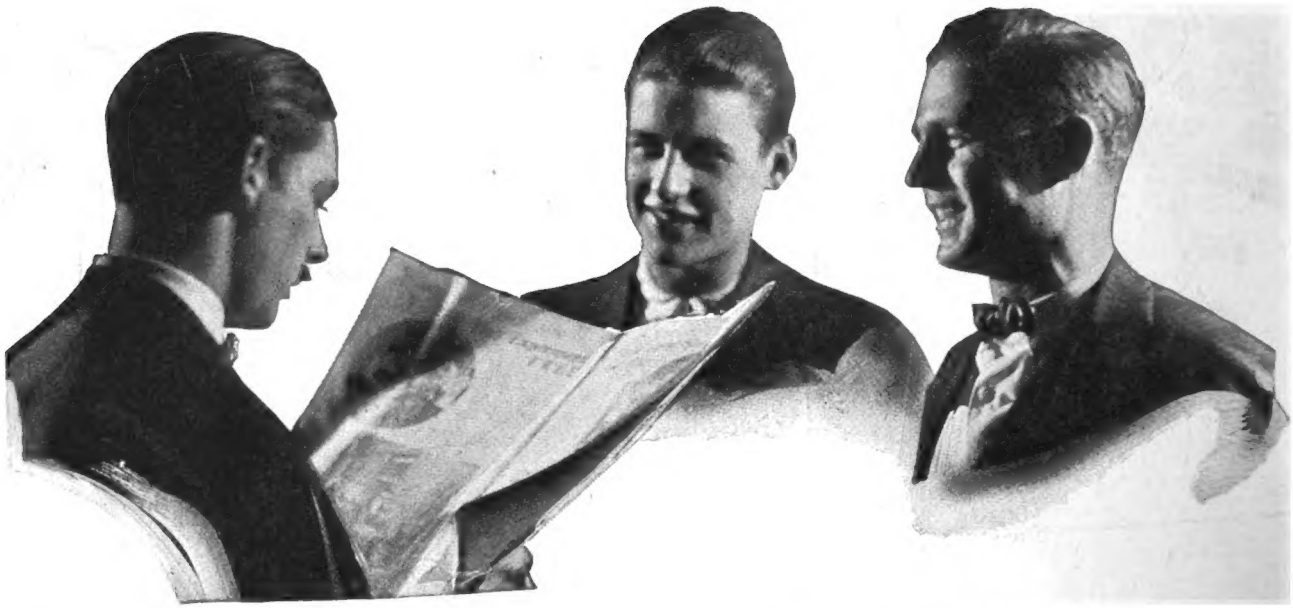

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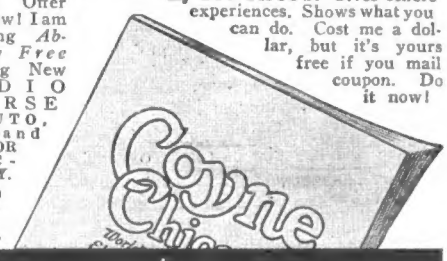

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Vol. XII.
Whole No. 144

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

April, 1925
No. 12

IN OUR NEXT ISSUE

Did You Ever See a Dinosaur?

We will tell of a new motion picture, "The Lost World," in which huge monsters of pre-historic times return to scenes of the present day and devastate countrysides, terrifying the population. We will show how these monsters have been produced so that the film shows most realistic and likelife animals. In this article you will see photos of these creatures chasing a party of hunters and an explanation will accompany, showing how the photography was accomplished.

* * *

Will Atomic Energy Ever Be Released?

A prominent college professor will present in clear illustrations and concise descriptive matter the probable methods whereby atomic power or energy may in the future be released and will comment upon the result of releasing this enormous power before suitable means for controlling it are devised.

* * *

Can the Sex of Unborn Babies Be Determined?

Experiments by prominent American and foreign doctors point toward an ultimate realization of this point that has often been discussed by interested parties. Our article will deal with the complete process of determining the sex of unborn babies, giving full details.

* * *

Are You Contemplating a Vacation Trip?

If so, you will undoubtedly desire to take a radio receiving set with you. An authoritative article in our next issue will deal with complete constructional details of an exceedingly compact yet efficient radio set. This type of set is completely self-contained with the exception of the antenna and ground. All of the batteries are placed within the case and the tubes are entirely protected when the cover of the container is lowered.

The above are just a few of the treats in store for our readers in the next issue.

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EDITORIAL & GENERAL OFFICES: 53 Park Place, New York City

Published by Experimenter Publishing Company, Inc.
(H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y).

Publishers of SCIENCE & INVENTION, RADIO NEWS, THE EXPERIMENTER and MOTOR CAMPER & TOURIST.

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All communications and contributions to this journal should be addressed to Editor, SCIENCE AND INVENTION, 53 Park Place, New York City, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication.

SCIENCE AND INVENTION, Monthly. Application as second class matter made at New York, N. Y. with additional entry at Long Island City, N. Y. Post Office, under act of Congress of March 3, 1879. formerly entered at Jamaica, N. Y. Entered on Sept. 15, 1924, at Post Office, Atlanta, Ga., Chicago, Ill., Los Angeles, Cal., San Francisco, Cal. Title Registered at the Patent Office. Copyright, 1925, by E. P. Co., Inc., New York. The Contents of this Magazine are copyrighted and must not be reproduced without giving full credit to the publication. SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulations.

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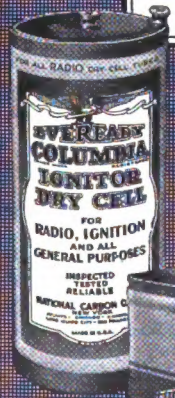

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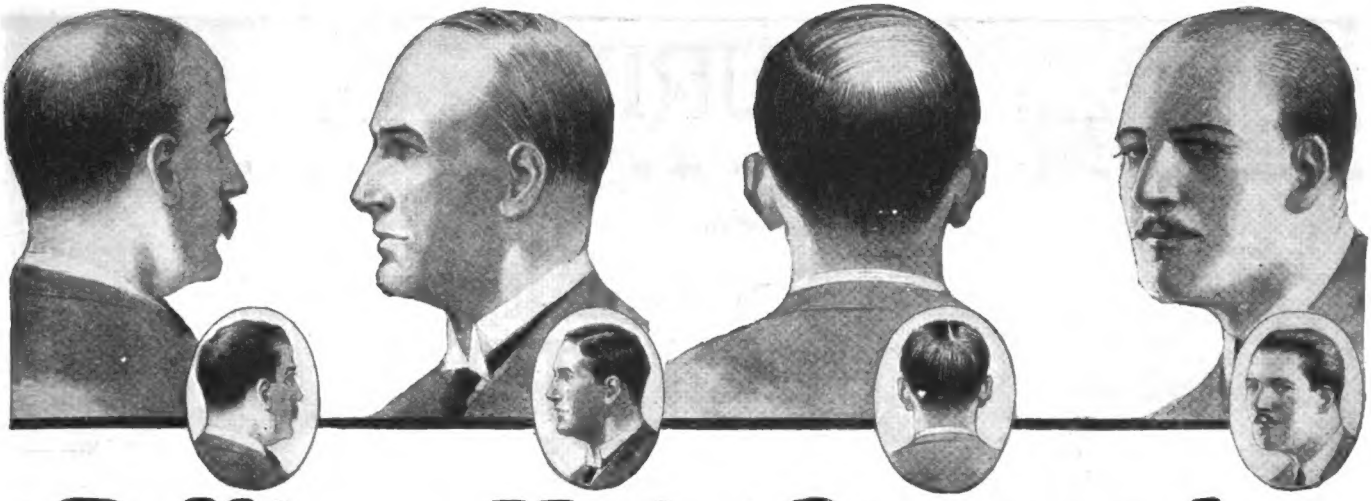

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Volume XII
Whole No. 144

Science and Invention

April, 1925
No. 12

H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., ASSOCIATE EDITOR
Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

Radio and the Student

By HUGO GERNSBACK

A RECENT newspaper report quotes a well-known college professor as saying that Radio is acting as a detriment to school studies. The professor ventured to say that he had observed that a great many students, as well as younger boys still in school, were neglecting their studies due to radio. We have heard arguments against radio, but this one is so novel and the eminent professor is so serious about this contention that we find it necessary to discuss the matter at length.

I BELIEVE THAT:

Radio will be one of the great assets of humanity.

The professor makes the contention that the students sit up all night long trying to receive long distance messages or otherwise fritter away their time, becoming unfit for their work the next day. He recommends to parents that all radio apparatus should be kept under lock and key while there is a young boy in the house.

To begin with, it is perfectly true that boys do sit up at times until the wee hours in the morning, trying to receive cherished DX stations. It is also true that they occasionally spend a good deal of time constructing sets, but the good professor forgets that they do not do this night after night, but rather do it occasionally. And, after all, night study, whether it be radio, or geometry, seems to be about in the same class. The good professor will not deny that when he was a youngster he burned the midnight oil more than once. And what is the difference whether you study radio and sit up with it, or study arithmetic, or Latin?

I BELIEVE THAT:

Radio, by bringing nations into closer relations, will prevent many wars of the future.

Personally, we make the contention that, if anything, radio should be the preferred study, for the following reasons: To begin with, there is nothing that sharpens the wits of a young man as does radio. It takes real brains and good training to construct a set yourself and operate it. Almost any one can read a book and study it, but not every one can master the intricacies of radio circuits. Not only does radio give the student an electrical and mechanical education that later will prove most valuable to him, but, on the other hand, it will also give the student a manual training that later on may prove a big asset.

I BELIEVE THAT:

The boy Radio Experimenter of today is tomorrow's radio manufacturer.

A radio set builder must be a carpenter, an electrician, a metal worker, a tinsmith, and a radio engineer, all rolled into one. We know of no study where more varied acquirements are involved than in radio.

Suppose a student does sit up into the early hours of the morning with his set. At least he derives a benefit from doing so, much more so, to our minds, than spending the same amount of time in studying Latin, that may never do him much good in later years, unless he aspires to become an attorney or a doctor. One thing the DX radio aspirant learns and that is geography.

Some of the greatest minds in the radio industry today are those who had the tenacity of purpose and backbone to sit up all night long, experimenting with radio, which gave them an education which they could never have obtained in any other way.

While we do not recommend young men to dispense with sleeping, spending night after night with their sets, still we do say that an occasional nocturnal effort of this kind is rather to be encouraged than otherwise.

The crime of the world is idleness. The boy devoted to radio will be all astir and his new mental activity will make him a better student than ever of arithmetic and of the whole school curriculum.

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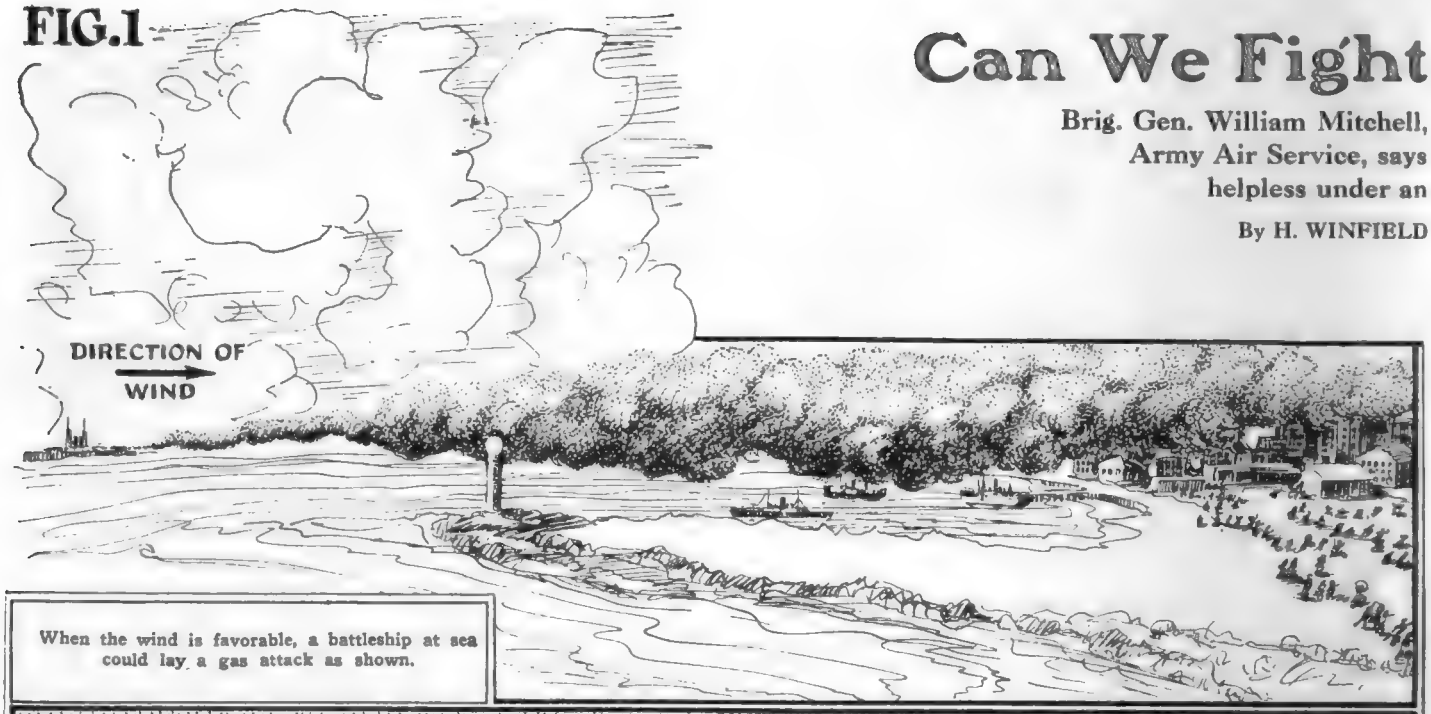
Can We Fight

Brig. Gen. William Mitchell, Army Air Service, says helpless under an

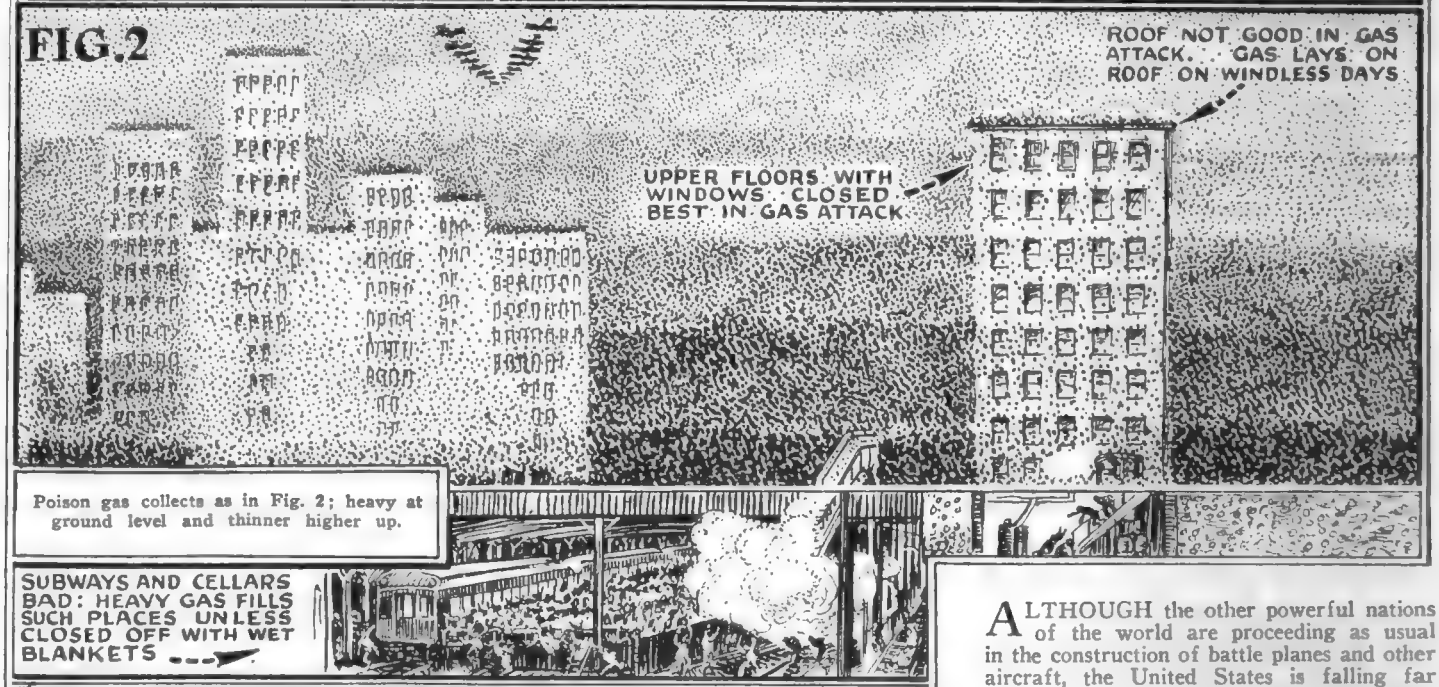
By H. WINFIELD

FIG.1



When the wind is favorable, a battleship at sea could lay a gas attack as shown.

FIG.2


ROOF NOT GOOD IN GAS ATTACK. GAS LAYS ON ROOF ON WINDLESS DAYS
UPPER FLOORS WITH WINDOWS CLOSED BEST IN GAS ATTACK
SUBWAYS AND CELLARS BAD: HEAVY GAS FILLS SUCH PLACES UNLESS CLOSED OFF WITH WET BLANKETS

Poison gas collects as in Fig. 2; heavy at ground level and thinner higher up.

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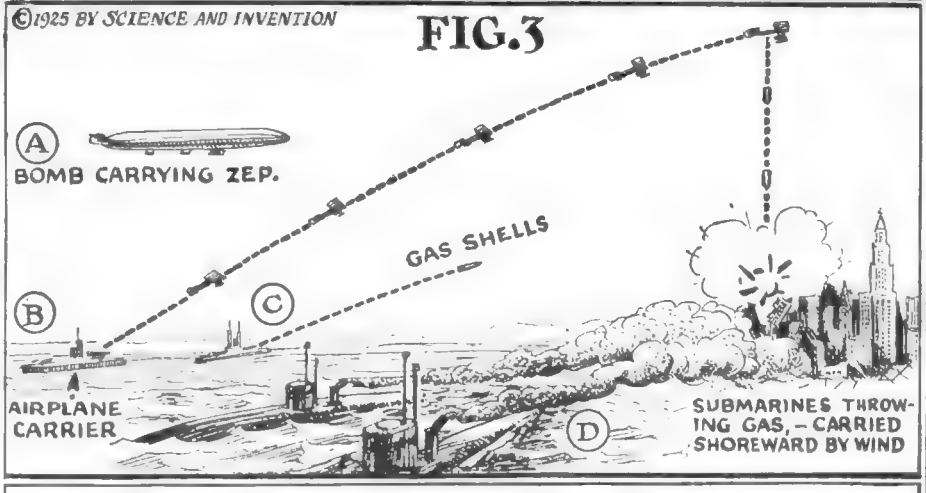
FIG.3



Various agencies could be used by enemy powers for attacking United States cities with gas. These are shown above and consist of airplanes and Zeppelins carrying gas-bombs, battleships firing gas-containing shells and submarine evolving clouds of gas to be carried shoreward by favorable winds. Any of these agencies could quickly make even the largest cities uninhabitable.

ALTHOUGH the other powerful nations of the world are proceeding as usual in the construction of battle planes and other aircraft, the United States is falling far behind. According to Brig. General William Mitchell, New York, the greatest city of the United States and the most important seaport, is defenseless against an aerial attack. Only 19 planes in the United States today are fit to fight, and the General says that because of their age and condition he would not be responsible for ordering out any one of these planes for active battle service. He furthermore states that commercial aviation in the United States is practically at a standstill, whereas in other countries that branch of aerial navigation is progressing with leaps and bounds.

In the particular case of New York City, a fleet of large battle planes could quickly annihilate every living being. As shown in Fig. 2, gas could be spread over the entire city by any of the methods indicated in Fig. 3. The gas would settle in the cellars and subways and would penetrate every building. Every line of transportation would be completely tied up, and as New York City is entirely surrounded by water, the millions of inhabitants could not leave the city quickly enough to prevent enormous loss of life. Our aerial defense needs stimulating.

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War Gas Attacks?

Assistant Chief of the that we would be aerial gas attack.

SECOR

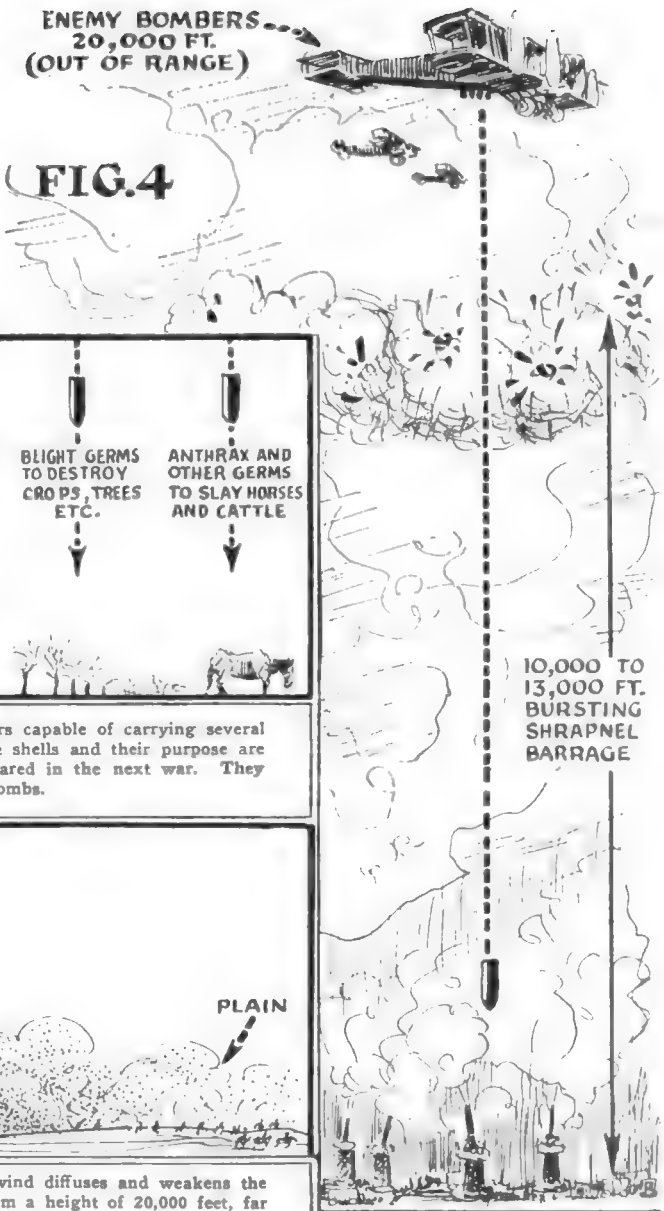


FIG. 4

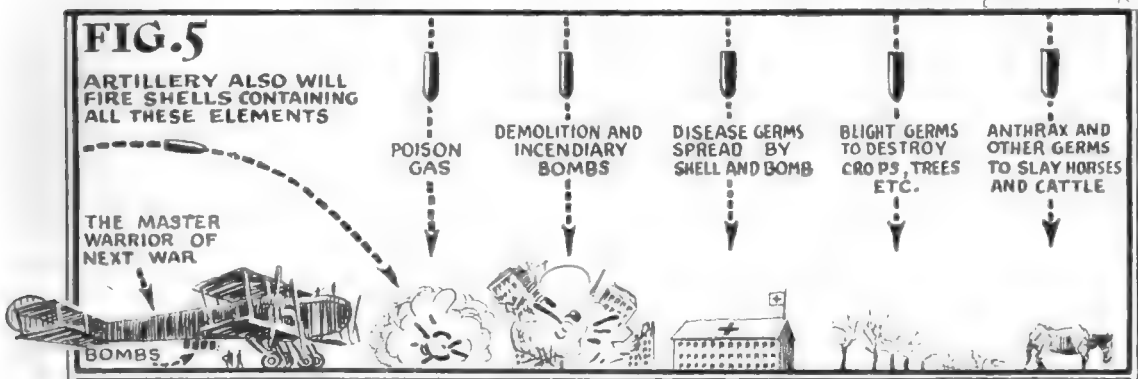
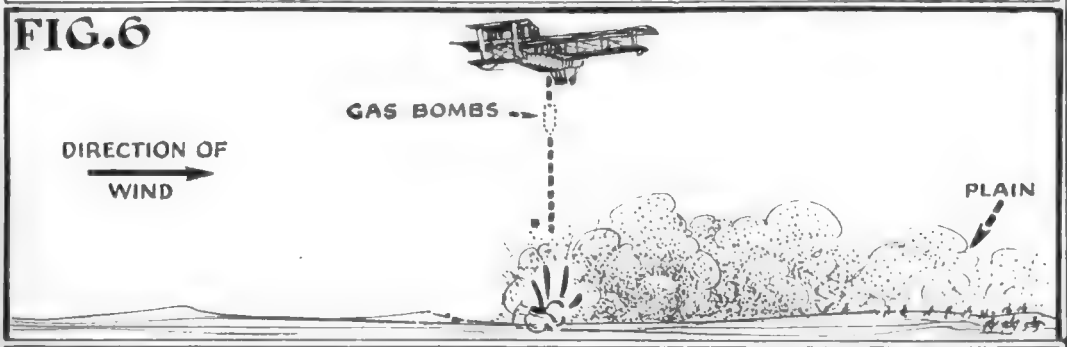


FIG. 5
ARTILLERY ALSO WILL FIRE SHELLS CONTAINING ALL THESE ELEMENTS
POISON GAS
DEMOLITION AND INCENDIARY BOMBS
DISEASE GERMS SPREAD BY SHELL AND BOMB
BLIGHT GERMS TO DESTROY CROPS, TREES ETC.
ANTHRAX AND OTHER GERMS TO SLAY HORSES AND CATTLE
THE MASTER WARRIOR OF NEXT WAR
BOMBS

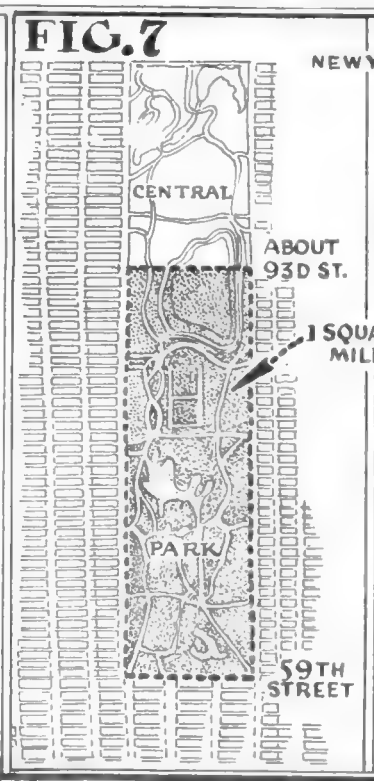
Undoubtedly the master warriors of the next war will be giant aerial bombers capable of carrying several tons of gas-bombs and other death-dealing projectiles. Various types of these shells and their purpose are illustrated in the above drawing, Fig. 5. Even the animals will not be spared in the next war. They will be given special attention in the form of germ bombs.

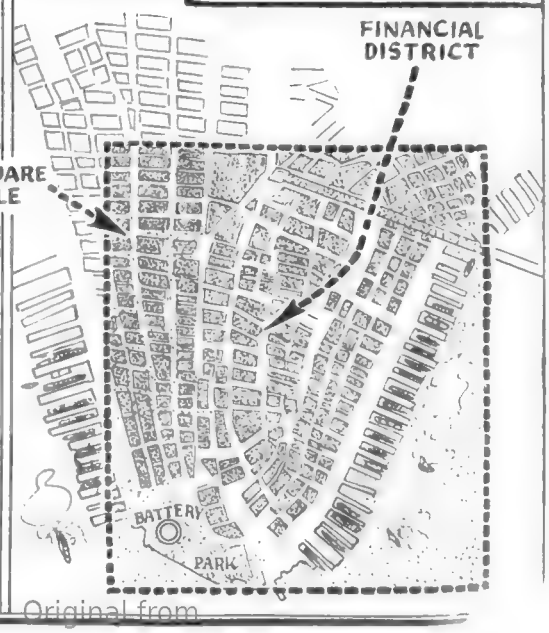


In the event of a poison gas attack, an open plain is the safest place. The wind diffuses and weakens the gas as in Fig. 6. Giant bombers of the future will wreak havoc on cities from a height of 20,000 feet, far above the present range of anti-aircraft guns as shown in Fig. 4.

UNDOUBTEDLY the next war is going to be one fought in the main with poisons and aircraft. Foreign powers have in the recent past made and are still making far-reaching experiments with various types of poison gases. Furthermore, one foreign nation has at least two thousand five hundred airplanes in active peace-time service and possibly four thousand eight hundred other planes in reserve. Contrast this with our nineteen battleplanes and our very few serviceable observation planes. Suppose that the above-mentioned foreign power were to declare war on us and establish an air base on o. near this continent. Two thousand of her planes, each carrying a quarter of a ton of gas, could drop five hundred tons of death-dealing material. Such a fleet of planes could wipe out any of the large cities of this country in record time. And the tragic part of this whole story is that the inhabitants of a city would probably have no knowledge that an attack was being made until they felt the effects of the gas. This would be particularly true in the case of gas bombs dropped outside of city limits, so that the clouds of poisonous material shall be blown toward the habitations by wind.

The effectiveness of gases is increased by the fact that they hug the ground and penetrate cellars, subways and coal mines.





Thirty planes, each carrying one ton of gas bombs could gas an area of one square mile, see Fig. 7, covering most of Central Park or as in Fig. 8, the financial district in lower New York City.

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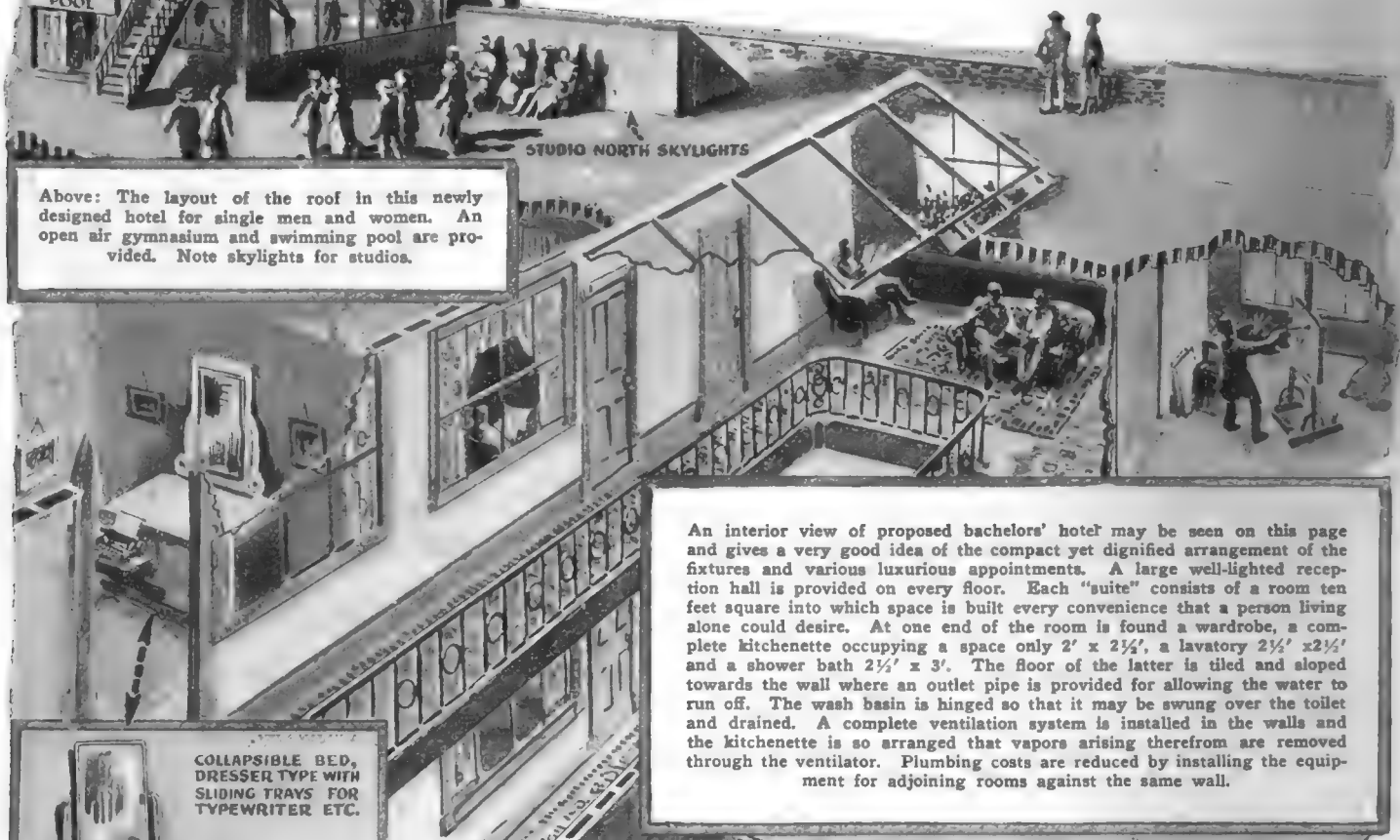
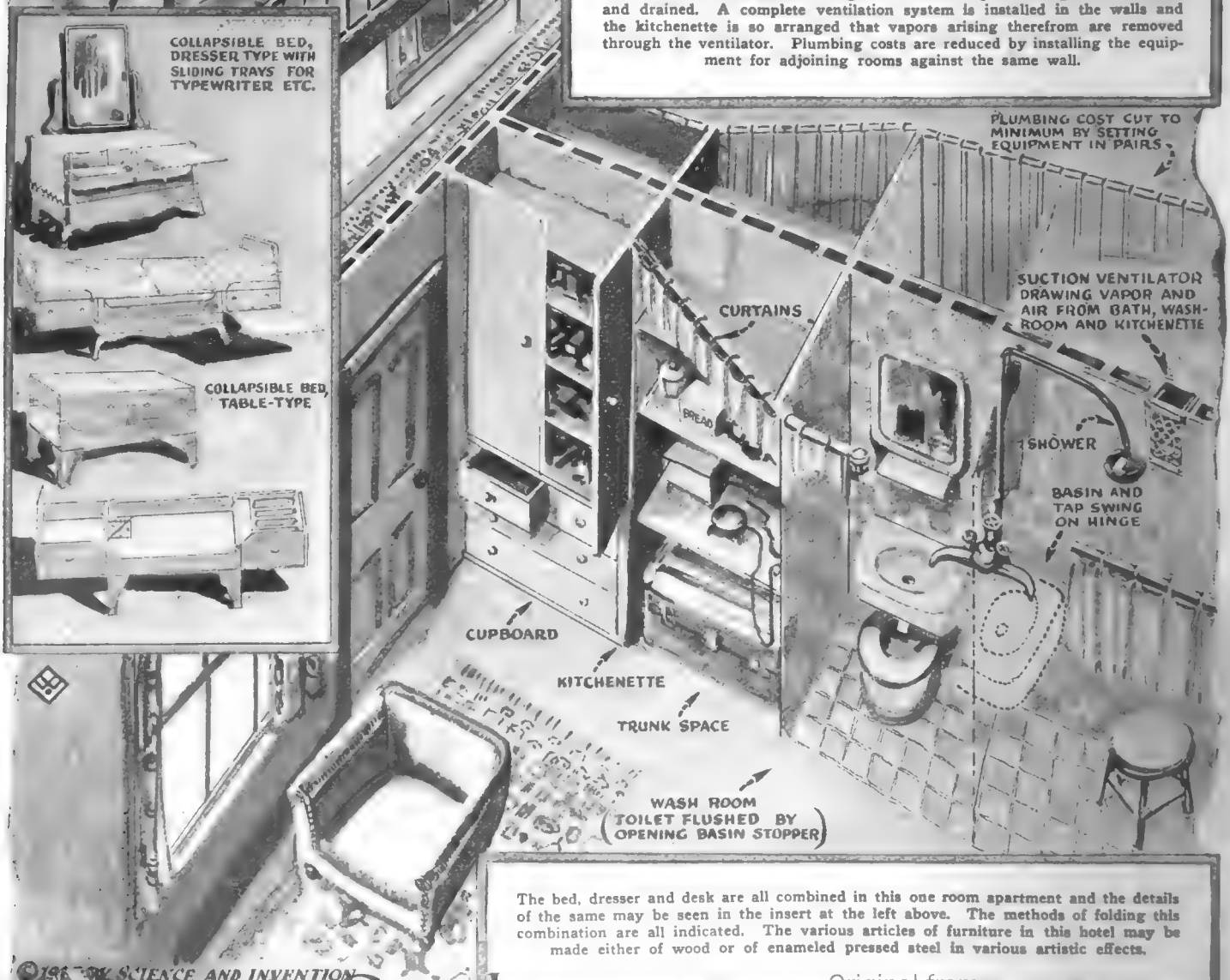
Hotel for Bachelors

By L. SCHUMACHER

Above: The layout of the roof in this newly designed hotel for single men and women. An open air gymnasium and swimming pool are provided. Note skylights for studios.



An interior view of proposed bachelors' hotel may be seen on this page and gives a very good idea of the compact yet dignified arrangement of the fixtures and various luxurious appointments. A large well-lighted reception hall is provided on every floor. Each "suite" consists of a room ten feet square into which space is built every convenience that a person living alone could desire. At one end of the room is found a wardrobe, a complete kitchenette occupying a space only 2′ x 2½′, a lavatory 2½′ x2½′ and a shower bath 2½′ x 3′. The floor of the latter is tiled and sloped towards the wall where an outlet pipe is provided for allowing the water to run off. The wash basin is hinged so that it may be swung over the toilet and drained. A complete ventilation system is installed in the walls and the kitchenette is so arranged that vapors arising therefrom are removed through the ventilator. Plumbing costs are reduced by installing the equipment for adjoining rooms against the same wall.


COLLAPSIBLE BED, DRESSER TYPE WITH SLIDING TRAYS FOR TYPEWRITER ETC.
COLLAPSIBLE BED, TABLE-TYPE
PLUMBING COST CUT TO MINIMUM BY SETTING EQUIPMENT IN PAIRS
SUCTION VENTILATOR DRAWING VAPOR AND AIR FROM BATH, WASHROOM AND KITCHENETTE
CURTAINS
BREAD
SHOWER
BASIN AND TAP SWING ON HINGE
CUPBOARD
KITCHENETTE
TRUNK SPACE
WASH ROOM (TOILET FLUSHED BY OPENING BASIN STOPPER)

The bed, dresser and desk are all combined in this one room apartment and the details of the same may be seen in the insert at the left above. The methods of folding this combination are all indicated. The various articles of furniture in this hotel may be made either of wood or of enameled pressed steel in various artistic effects.

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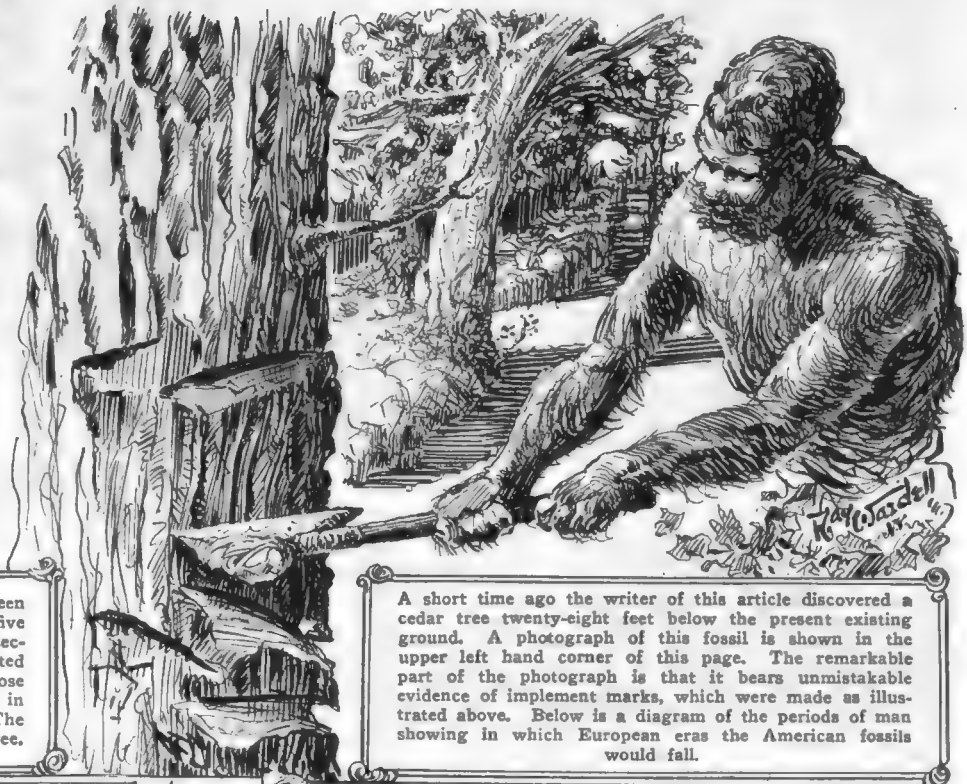
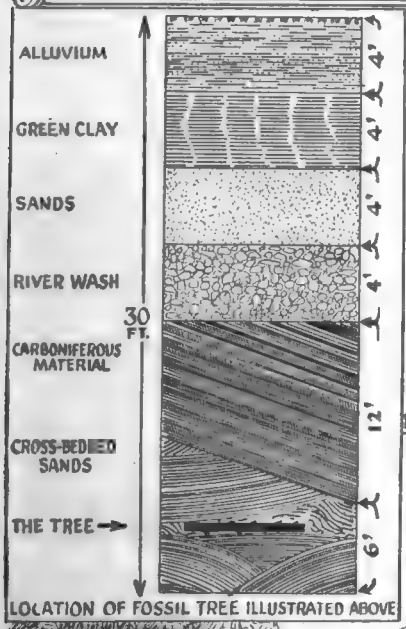
Axe Marks 25,000 Years Old

By JOHN R. HOWARD, Reporter No. 5058

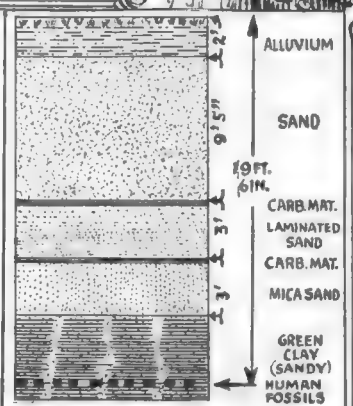


The eyes of the entire scientific world have been turned toward Los Angeles as the finding of five prehistoric remains of man have shown this section of the United States to have been inhabited 25,000 years ago. These fossils are as old as those of the Aurignac race of Europe and were found in the quicksand of the Pleistocene period. The drawing below shows the location of the fossil tree.

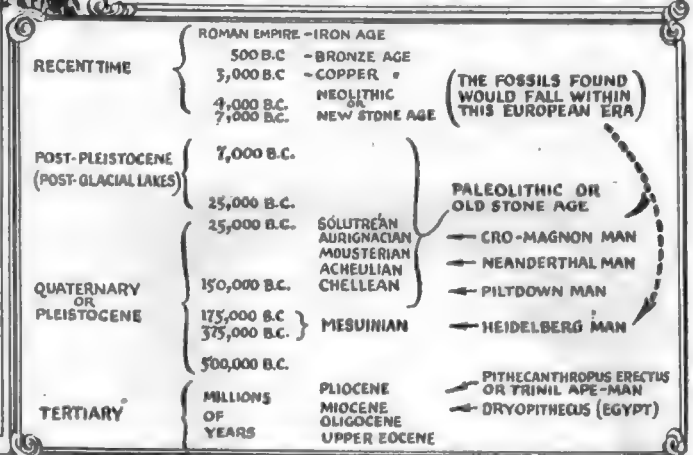
A short time ago the writer of this article discovered a cedar tree twenty-eight feet below the present existing ground. A photograph of this fossil is shown in the upper left hand corner of this page. The remarkable part of the photograph is that it bears unmistakable evidence of implement marks, which were made as illustrated above. Below is a diagram of the periods of man showing in which European eras the American fossils would fall.



LOCATION OF FOSSIL TREE ILLUSTRATED ABOVE



LOCATION OF HUMAN FOSSILS JUST FOUND



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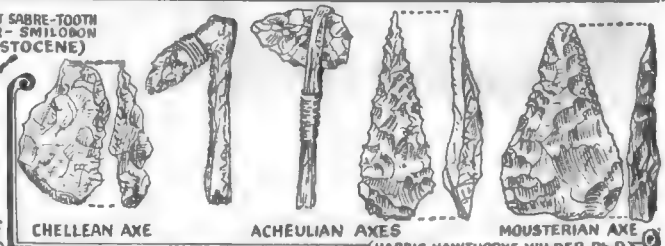

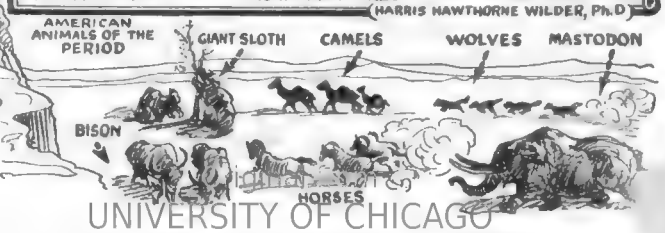

On this page are also shown the development of the face of man and the development of man's weapons. At the time when this tree was alive the animals shown here also roamed the plains.

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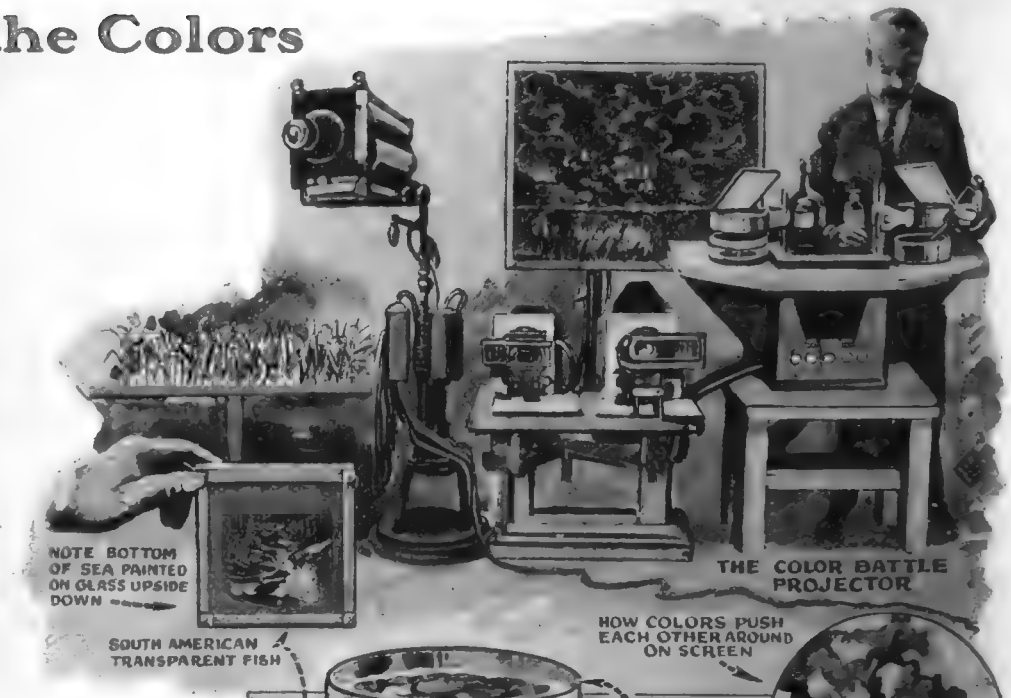
The Battle of the Colors

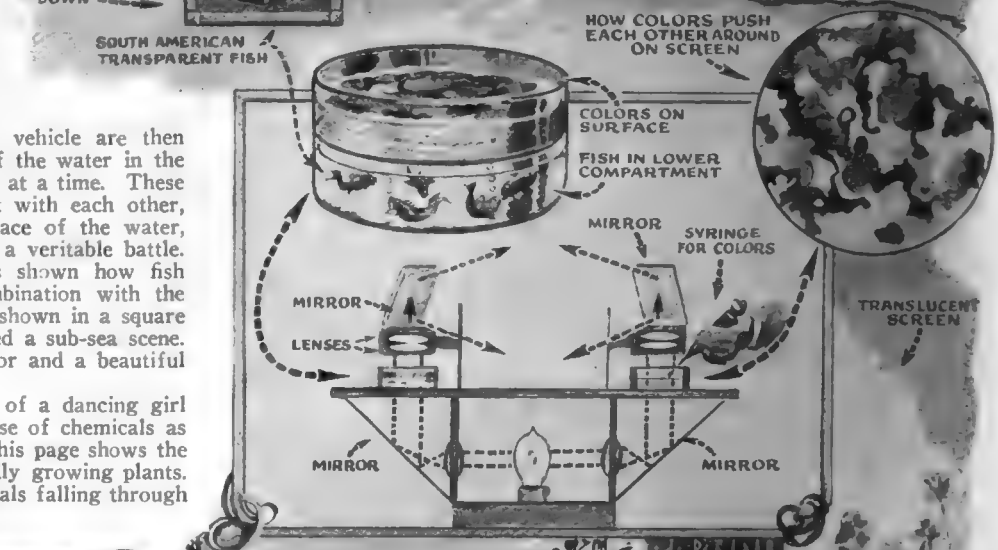
By A. P. PECK

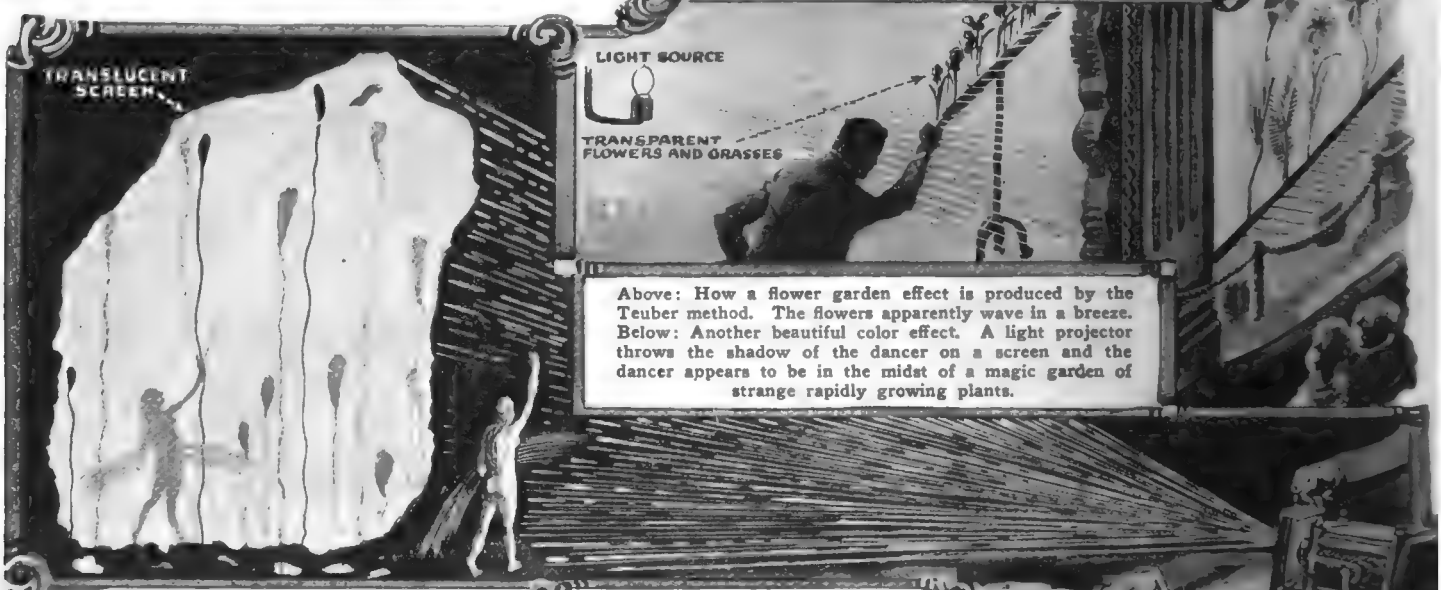
ONE of the most brilliant effects that has ever been produced on any stage is that presented by Max Teuber in The Vanities. Mr. Teuber is the only originator of chemical optical stage effects in the world today. Our cover illustration gives some idea of the beautiful effects produced on a translucent screen by the color-battle projector illustrated in the upper right-hand corner of this page. The various other apparatus beside the color projector is used in connection with other parts of Mr. Teuber's production and are illustrated in use below. The projector at the extreme left produces an effect of water waves.

Our center illustration shows how the battle of colors is projected on the screen. Usually one projector, but occasionally two are brought into play. A light from an incandescent bulb or other source is concentrated through lenses and reflected by mirrors through a glass bottom receptacle to another mirror set at an angle which throws the light upon the back of the screen. Mixtures of aniline dyes and some oily vehicle are then ejected from syringes upon the surface of the water in the container as shown, one color being placed at a time. These colors when freshly prepared do not mix with each other, but perform weird gyrations on the surface of the water, thrusting each other aside and producing a veritable battle. At the left of our center illustration is shown how fish may be projected on the screen in combination with the color battle. These fish are also used as shown in a square glass tank on the face of which is painted a sub-sea scene. This tank is placed in front of a projector and a beautiful effect produced on the screen.

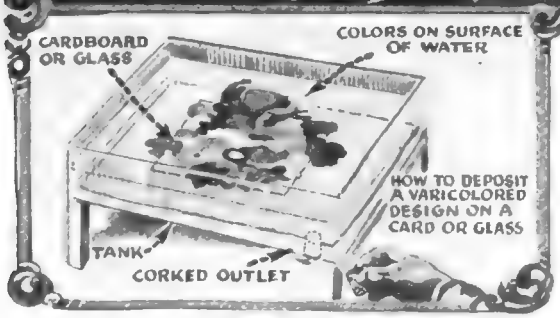
Another beautiful effect is the shadow of a dancing girl projected on a translucent screen. The use of chemicals as shown in the lower right-hand corner of this page shows the dancer moving through a garden of rapidly growing plants. The "plants" are produced by solid chemicals falling through liquids and leaving a trail of color behind.

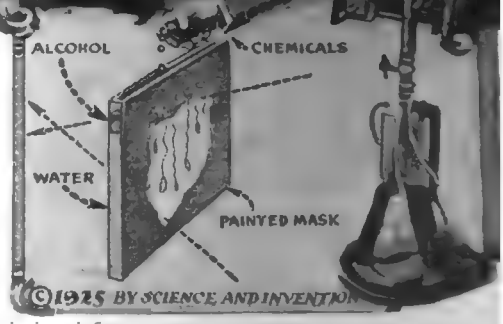






Above: How a flower garden effect is produced by the Teuber method. The flowers apparently wave in a breeze. Below: Another beautiful color effect. A light projector throws the shadow of the dancer on a screen and the dancer appears to be in the midst of a magic garden of strange rapidly growing plants.





Right: How the rapidly growing effect is produced. A square glass tank on the face of which is painted a mask is placed in front of a projector as at the extreme right. A layer of pure alcohol is on top of the water and when water or alcohol-soluble aniline crystals are dropped in the tank, they sink to the bottom, leaving an arborescent trail of color after them. The use of a lens inverts the reproduction on the screen and the colors appear to grow from the bottom to the top. Left: How the battle of colors may be reproduced with anilines in alcohol or terpentine.

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Outdoor Scenes Duplicated In Studio

By HARRY VAN DEMARK

LARGE motion picture producers to-day save considerable expense by duplicating great outdoor scenes in the studio. Under the old plan, the company was transported to the location and brought back to the studio for interior work. Now, however, the art directors, designers and creators, photograph a possible scene of location and reproduce it in detail in the studio where powerful lighting effects may be obtained. This development in settings for motion pictures started only a few years ago, it having been found that backgrounds more neutral and less ornate than they used to be give better composition and lend themselves to more artistic treatment.

Reproduction of gigantic Buddha statue.

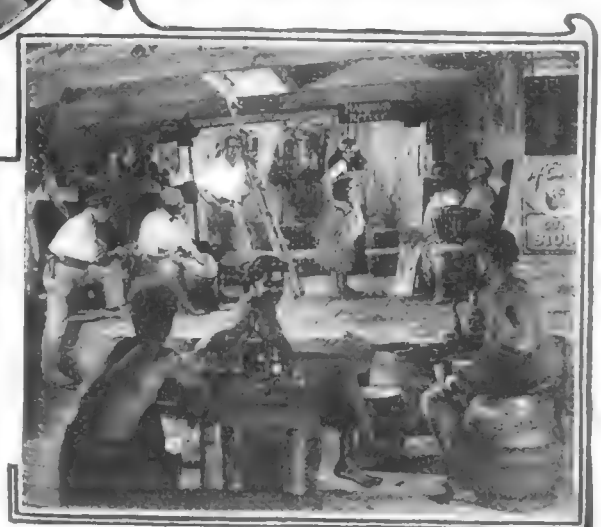
Typical English cottages constructed on Long Island for a recent photoplay are shown above.

The background of the scene above might be the Hudson by moonlight, so realistic is it. This was produced in the studio. Moon, cloud and wave machines were used.

The car above is reproduced in detail and is an exact duplicate of the railway system at Monte Carlo.

Ready to shoot a Chinese canal constructed in a gigantic tank in the studio.

At the left one may see the members of the research department of a large motion picture concern taking photographs of various spots in the South Sea Islands. The one here illustrated is a sort of a wayside inn where dancing takes place and liquors are served to travelers. The still photographs are then developed and the duplicate scene is faithfully constructed by the art director after all atmosphere and props have been built in accordance with specifications.



The scene as it looks in the movies.

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The Aerial Taxicab

Left: Colonel Hartney with his improved plane which will make aerial taxis possible. This plane can land in a space 35 feet long at a speed of only 30 miles an hour. The angular wings prevent it from side slipping as shown in the insert at left. The plane is so designed that it cannot lose flying speed and so stall in the air.

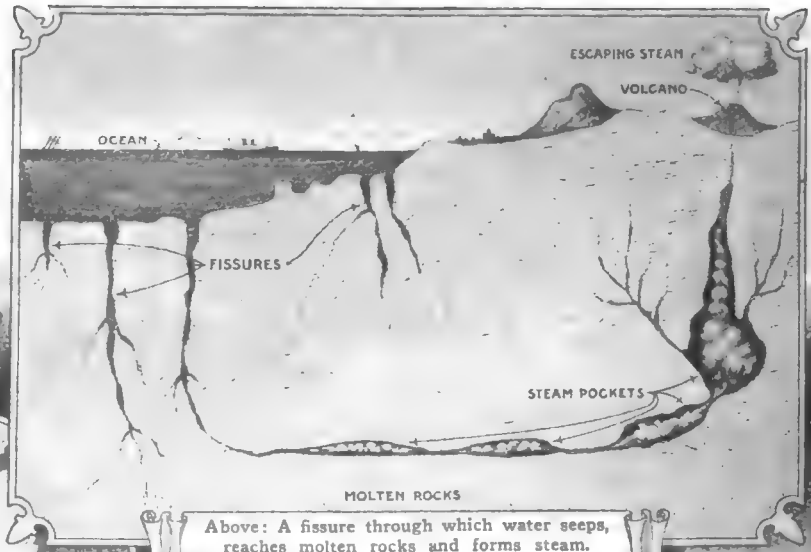
Left: Interior of air taxicab showing conveniences. Below: Automobile taxis co-operating with air cabs.

The improved tail of the aerial taxicab is shown at the left and directly above it the improved braces, A, and the side wing joint, B.

If the plans of Colonel Hartney of the U. S. Air Service become a reality, aerial taxicabs charging 20c a mile may soon be quite common. —A. P. Peck.

Cause of Eruptions and Tidal Waves

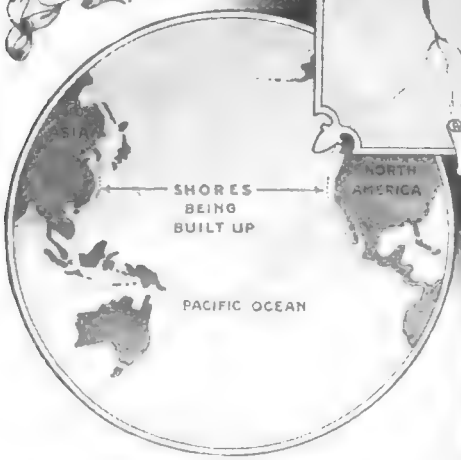
According to Captain T. J. J. See, earthquakes, tidal waves and volcanic eruptions can be directly traced to fissures in the earth's surface below oceans which connect with sections of molten rocks far below the surface as shown at the right. Steam is generated which, after collecting, bursts out of the volcano in the form of an eruption.



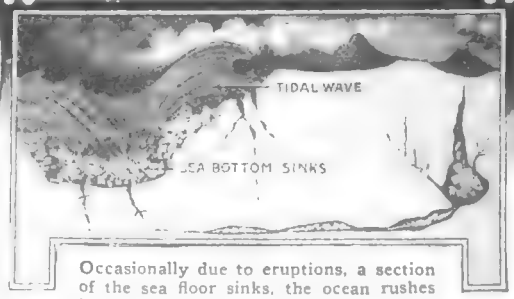
Above: A fissure through which water seeps, reaches molten rocks and forms steam.

The reasons underlying Captain See's theory is that volcanoes are rarely found more than 100 miles from a large body of water. Furthermore, volcanoes become extinct because the shores build up and the water seepage to the molten rocks is stopped. Where there is no steam, there can be no volcanic eruptions.

Below: Shores of continents building up.

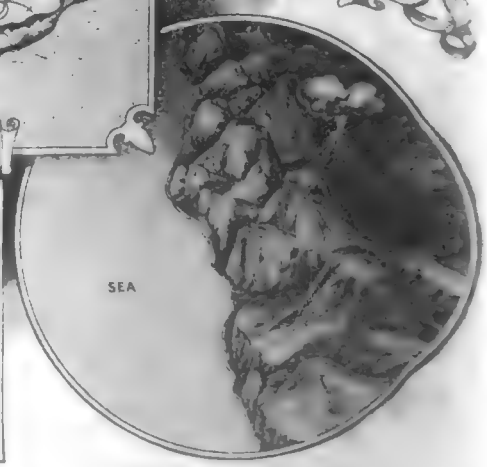


rthquakes on both sides of Pacific cause shores build up and ocean to become narrower.



Occasionally due to eruptions, a section of the sea floor sinks, the ocean rushes in as shown above, then surges shoreward in a huge tidal wave.

Below: Proximity of volcano to sea.



As in lower center illustration, sinking is due to shoreward movement of lava.

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Mummy Changes to Dancer

A VERY beautiful illusion is found in Miss Crystal Spencer's dancing act. Miss Spencer who specializes in classical East Indian and Hawaiian dances is not seen as the curtain rises. In the center of the stage a large mummy case holding a mummy is in evidence. The body tightly wrapped in bandages now gradually vanishes and slowly its features change to those of a dancing girl. She comes to life, goes through her act and then takes her place in the empty mummy case again, in which she disappears. On the other hand, for a slight change in effect she may be seen in the mummy case or sarcophagus which gradually disappears, and she remains standing in front of a dark velvet background.

This latter version of the illusion is shown in the figure at the lower right-hand corner of the above illustration. It will be seen that a plate of sheet glass passes diagonally from one of the pillars of the back setting to the black curtain at an angle of forty-five degrees. On one side of this mirror is the sarcophagus concealed from the audience but really in front of the plate glass. When the sarcophagus is illuminated, its reflection upon the plate glass is seen by the audience, the plate glass acting as a mirror because of the black backdrop. Miss Spencer occupies the position in back of the plate glass, but she cannot be seen because that side of the apparatus is not illuminated. Gradually the lights illuminating the sarcophagus dim, while those in back of the plate glass illuminating the dancer are brought up to full brilliancy. The effect is that the object in back of the plate glass has been transformed from the one in front of the plate glass, be that what it may. It can be a mummy or a case, or a combination of the two, or the case can be placed in back of the plate glass, so the mummy itself will appear in front of it. The dotted lines in the diagram indicate the route taken by the dancer in coming to the center of the stage to complete her act. In returning, the lights are dimmed in the opposite direction and the dancer fades from view. The photo of Miss Spencer is shown in the insert above. It is a development of Pepper's ghost.

At Last—the Umbrella Hat

The attachment for straw hats shown here is a great protection in rainy or very hot weather.
—L. Schumacher.

There are several sty'es of these paper or oiled skin hat attachments. They are extremely light and afford ample protection.

The device slips over the straw hat and is held extended by thin bamboo sticks. It can be folded and put in the pocket.

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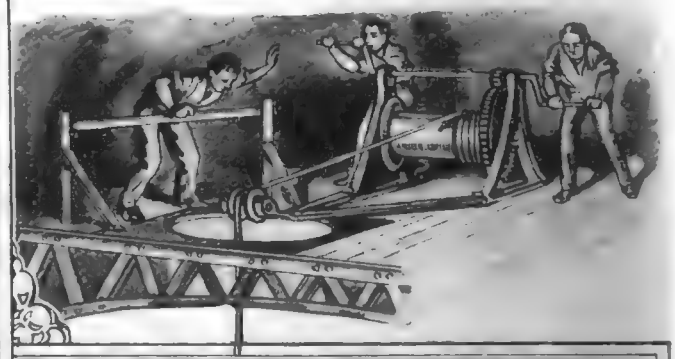
"The Phantom

By J. KELLEY

① The enormous size of the sets for this production may be seen in the above photograph.



② Above: Chandelier apparently falls. Really, it is lowered by a rope.

③

④

Above: A beautiful scene apparently taken on top of the Paris Opera House. A large, beautiful statue is used, but the rest of the setting is taken as below. Right: How One of the actors goes under water. A hollow walking stick provides him with air.

⑤ One of the highest paid actors on the American screen played the principal rôle in this picture. In the scene illustrated above a "double" took his place.

Scene painted on glass furnishes effect of distance.

⑥ Above: A grotesque scene apparently taken in a torture chamber.

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of the Opera"

BURLEIGH

⑦ Above: A creepy moment in the picture. A head floats along passageway. This scene is taken as at left, body belonging to head being clothed in black.

THE movie-going public has so long been fooled with miniature sets by various producers that it is quite refreshing to view some of the tremendous scenes in "The Phantom of the Opera," Universal's latest picture. Practically all of the scenes in this production were made full size. The entire Opera House in Paris was completely reproduced, structural steel framework being used. Under the original Opera House there are five cellars, many parts of which were reproduced by Universal. The Phantom in the story is reputed to live in these cellars. He threatens destruction if some of his wishes are not carried out and as a result, the enormous chandelier as in Fig. 2 crashes to the floor, killing hundreds. In reality, the chandelier is lowered slowly by a rope, while the camera is turned very slowly. When projected at normal speed, the result is astounding.

Throughout the entire picture enormous settings predominate. Note the statuary in Figs. 3, 4 and 9 and the complete Opera House interior as in Fig. 2. Due credit must be given the producing company for its pioneering work along this line. Undoubtedly, miniatures will soon be passé in favor of more realistic full sized sets.

⑨

⑧

⑩ Above: Some of the full sized statuary used in this picture. Many skilled artists were used for satisfactorily reproducing famous works of art. Below and left, Fig. 10: A scene in another torture chamber under the Opera House. Intense heat and optical illusions caused by mirrors soon tend to drive anyone insane who may be confined therein by the Phantom.

⑪ During a scene from "Faust," Satan appears on the stage only to vanish again in a puff of smoke, taking with him one of the other characters. Illustration above shows the two actors escaping into a trap door, while smoke sufficiently covers their movements to insure an effective illusion.

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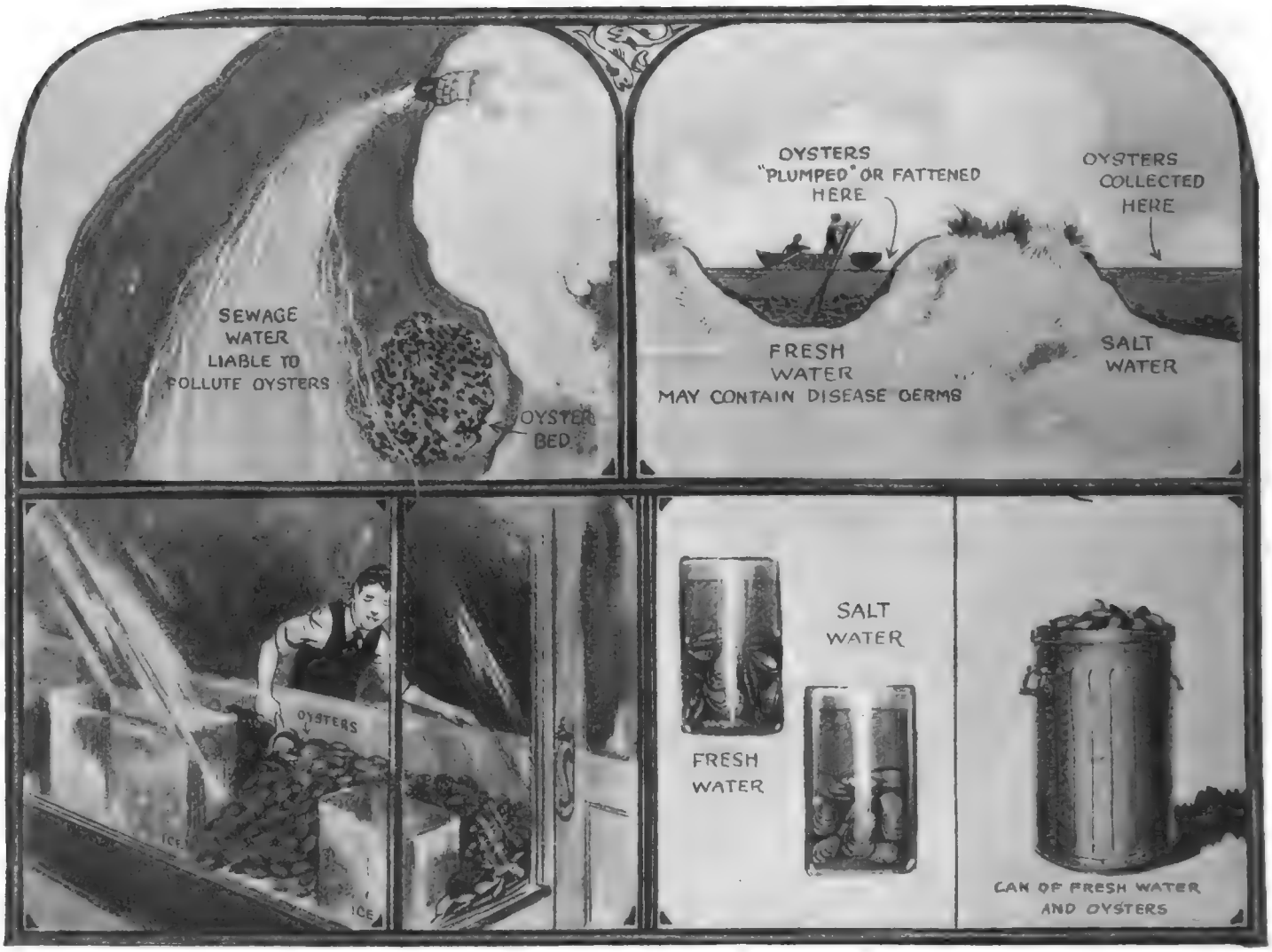
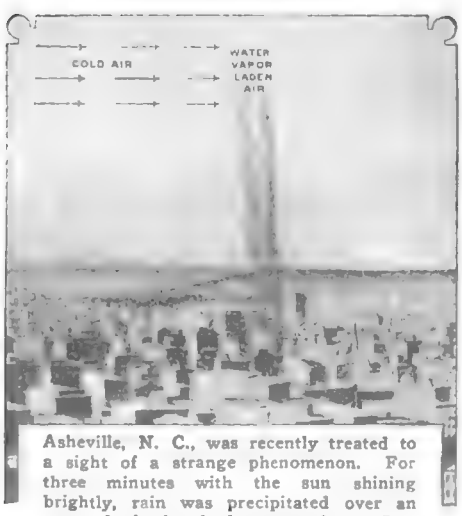
Why Some Oysters Are Diseased



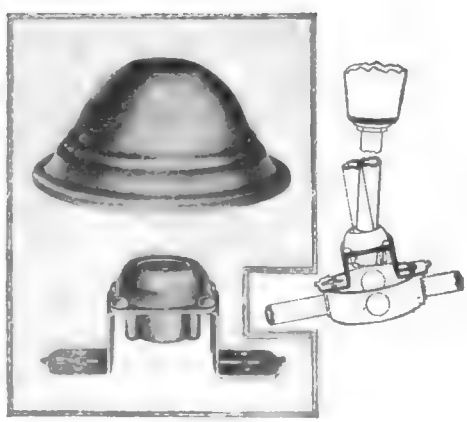
In recent months there has been a general alarm spread over this country relative to the consumption of oysters which may have been infected with disease germs. A few facts regarding the methods in which oysters may collect these germs will not be amiss. The upper lefthand illustration shows a birdseye view of a river in a cove of which is situated an oyster bed. If sewage water empties into this river and spreads out, there is great danger of the oysters becoming infected. A common practice of oyster growers is to fatten the bivalves in fresh water after collecting them from their native salt water. Such a process causes the oyster to swell and often to become "sick." Eating such an oyster is liable to make the consumer ill. The lower lefthand illustration shows a common scene of a restaurant window displaying live oysters and ice. If impure lake ice is used, water from the ice is liable to enter the molluscs and contaminate them. A home experiment showing how oysters are plumped is shown above. Leave a few in salt water and a few more in fresh water. After 10 to 12 hours, when opened, those in the fresh water will be found much fatter than the others. This artificial fatness is abnormal. Oysters left in cans containing fresh water, presumably to keep them in good condition, causes trouble due to unnatural fattening.

Local Rain



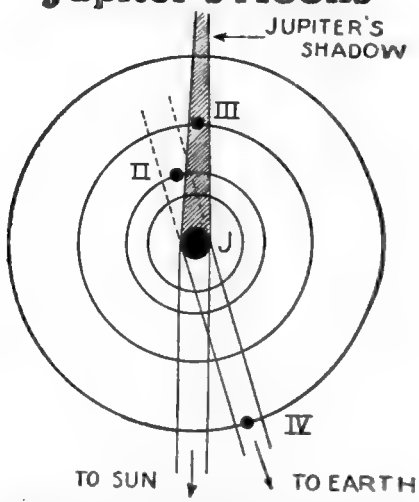
Asheville, N. C., was recently treated to a sight of a strange phenomenon. For three minutes with the sun shining brightly, rain was precipitated over an area of six hundred square feet. Surrounding territory was completely dry. As above, cold air meeting air charged with water vapor caused this freak rainfall. —J. Alfred Miller.

Plumb Fixtures



Fittings for use where every outlet box cannot be set straight and where vibrations are frequent have been produced and are illustrated above. The device can be aligned so that the fixture will hang plumb while shock absorbers take up vibrations.—Allen P. Child.

Jupiter's Moons



Jupiter has four moons, but they are not always visible. Drawing shows three positions where one or more satellites could not be seen. They would be either in front or in back of Jupiter or in that planet's shadow. —Ada Weber, M.A.

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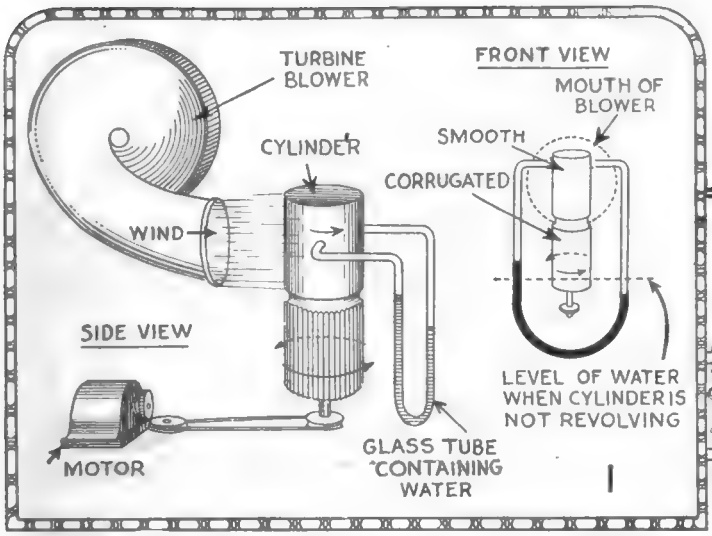
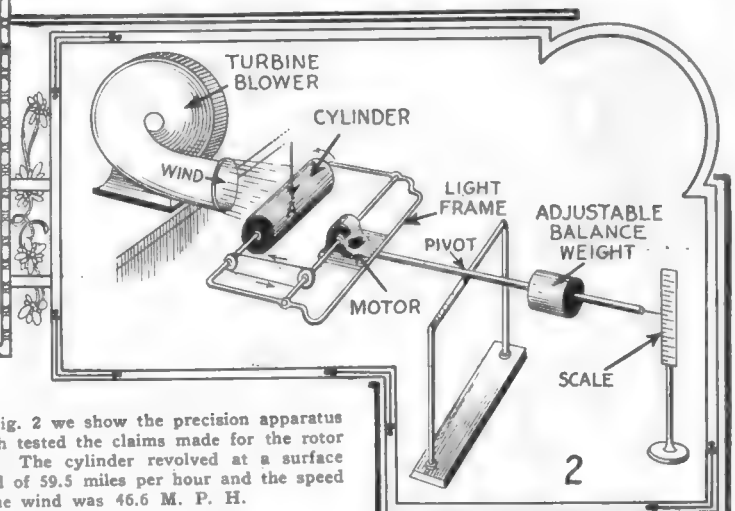
Our Tests With Flettner Rotors

By PROF. HAROLD F. RICHARDS, Ph. D.

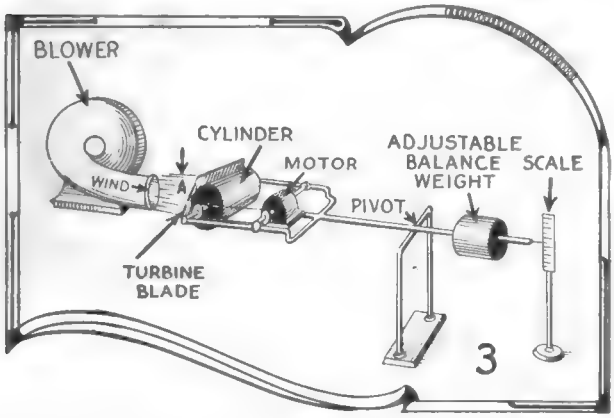
Measurements made with the apparatus shown in Fig. 1 prove that rough or corrugated rotors would be far more effective than the smooth cylinders Flettner has used. Revolving the cylinder in the path of an air current, the pressure produced by the reaction of the wind on the film of air which the cylinder drags around with it was indicated by the displacement of water in the Pitot tube. Experiments showed that by reversing the cylinders, the force on the corrugated surface was 4.5 times as great as on smooth cylinder.



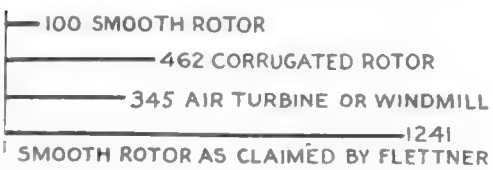
By fastening the blade of an air turbine to the rotor, but not revolving the latter, the efficacy of turbine drive was determined. The downward force was greatest when blades were inclined to the vertical at an angle of 34° giving a pressure of 4.27 lbs. per sq. ft. of the projected area with a wind speed of 46.6 M. P. H.

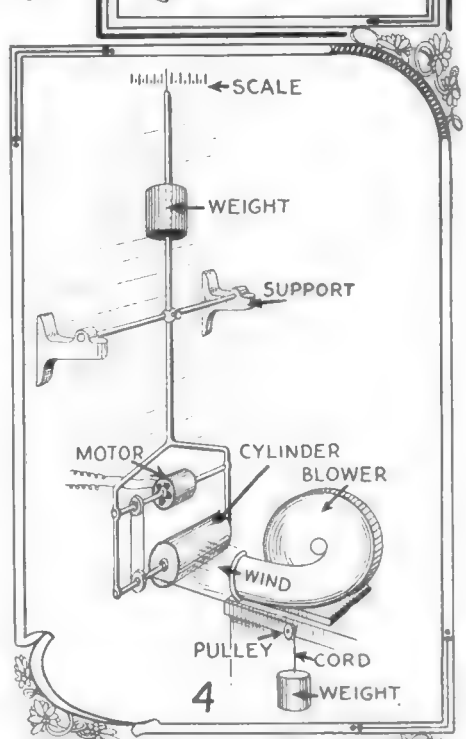


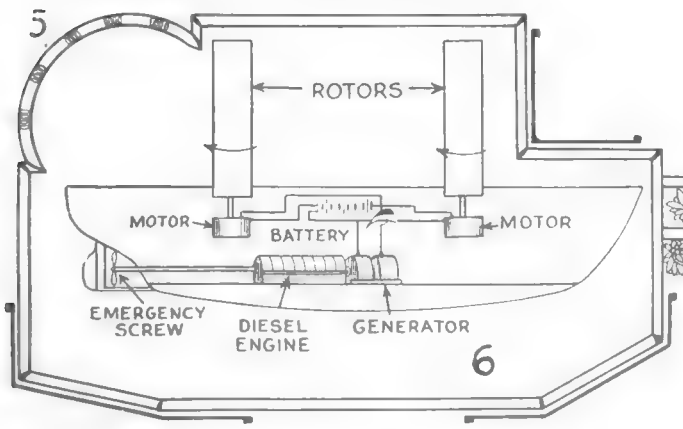
In Fig. 2 we show the precision apparatus which tested the claims made for the rotor ship. The cylinder revolved at a surface speed of 59.5 miles per hour and the speed of the wind was 46.6 M. P. H. At beginning of test the frame was balanced horizontally. When wind was turned on, the rotor was forced down and the balance weight moved to the right to bring the pointer back to its original position. Then the wind and rotor were stopped. The cylinder rose and a weight was added at A to restore balance. This weight measures the deflecting force of the wind. With smooth rotor pressure was 5.15 pounds, while with corrugated rotor it was 23.2 pounds per square foot of longitudinal cross-section of cylinder. Pressure on rotor in direction of wind was found as in Fig. 4. The apparatus was suspended as a pendulum with rotor at rest and in path of wind. By means of the weight, sufficient force was applied to counteract wind and was found to be 6.44 pounds per square foot of projected area. The air turbine ship in Fig. 7 has advantages over the rotor ship, although the latter gives slightly more propulsive force for same wind exposure. With turbine ship, storage batteries which drive electric motors for propulsion are charged by generators.

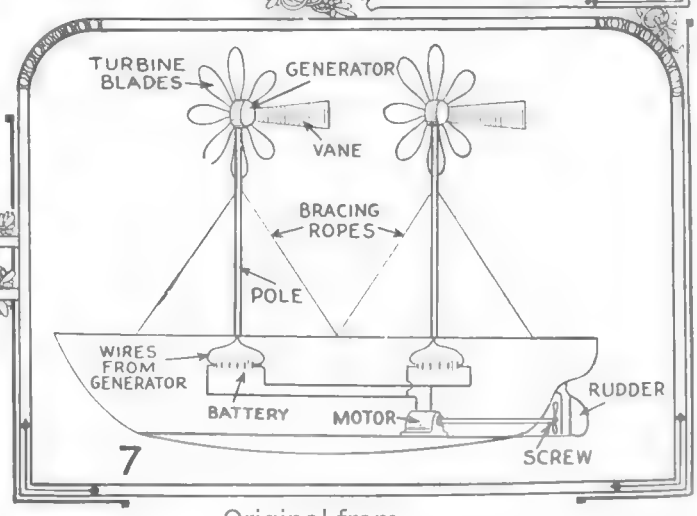


Below in Fig. 6 is shown Flettner's rotor ship. The lines and numbers on the chart below show relative pulling powers. The first three are based on our experiments, while the fourth is from data made public by Flettner. The discrepancy between lines 1 and 4 seems to indicate that the merits of the rotor ship have been greatly exaggerated, although the flanges on Flettner's rotors are said by authorities to greatly increase efficiency.









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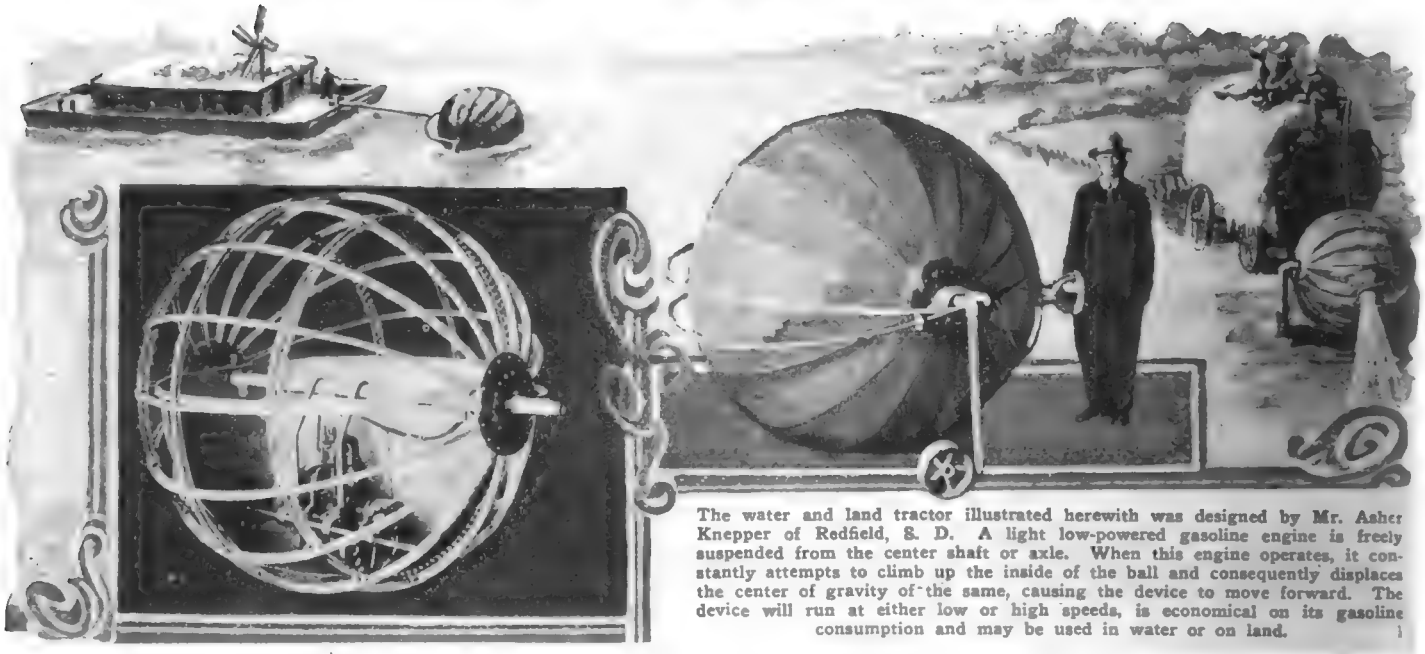
Water and Land Tractor

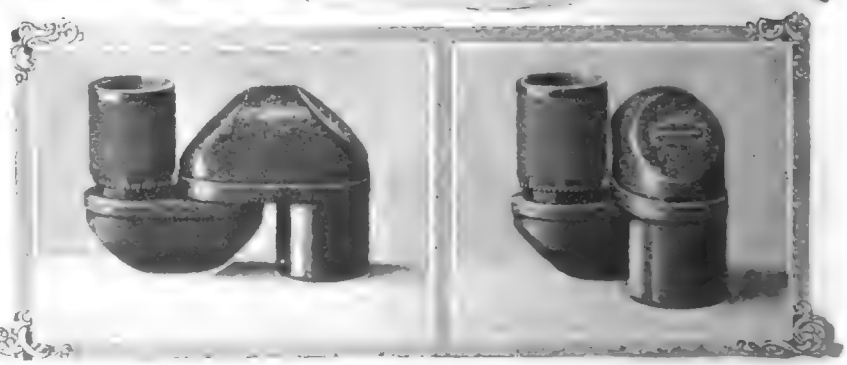


The water and land tractor illustrated herewith was designed by Mr. Asher Knepper of Redfield, S. D. A light low-powered gasoline engine is freely suspended from the center shaft or axle. When this engine operates, it constantly attempts to climb up the inside of the ball and consequently displaces the center of gravity of the same, causing the device to move forward. The device will run at either low or high speeds, is economical on its gasoline consumption and may be used in water or on land.

Telescope and Eye Distance Gauge

The instrument at the right is a foreign telescope only 2¾" long, which may be folded neatly into a box about the size of a match box. Its weight is about one-fifth of a pound, and it will magnify objects at short or great distances. Its field is at least three times larger than that of Galilean eight-power telescopes. —Dr. Albert Neuburger.

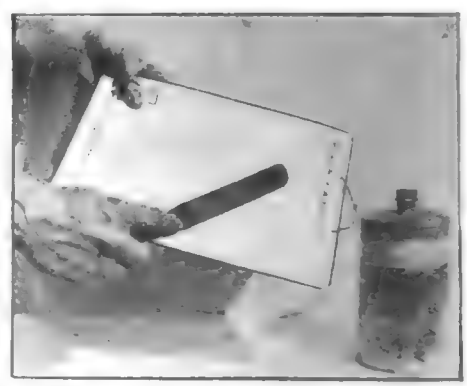
The device illustrated is used for measuring the distance between the eyes, so that optical instruments may be accurately suited to the user.



Traffic Mirrors

Mirrors are now used at street intersections in England to reflect images of cars approaching on side streets.

Protect Maps



Protect maps and charts and make them washable by coating with collodion spread on with a knife or use celluloid scraps dissolved in amyl-acetate. —R. B. Wailes.

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Oddities in the News

The largest automobile lamp ever made; for exhibition purposes by the General Electric Co.

If an automobile were as much larger than the average car as this lamp is bigger than the ordinary automobile lamp, it would be as long as seven Pullman sleepers.

Below is a photo of a German sub-sea armor which permits the diver to work five hundred and twenty-five feet below sea level for two hours at a time. These figures are from tests claimed to have been made. The diver works at atmospheric pressure.

The machine shown at the left takes X-ray pictures of pearls. If smooth gradations appear the pearl is of good quality, whereas the cultured pearl shows characteristic spots. The inventor is holding the camera and pearl.

The Otophone above is a new invention for the deaf. The device is essentially a microphone which is connected to the input side of a two-stage vacuum tube amplifying circuit carried in a small hand grip. This grip also contains the necessary batteries. The sound being amplified is conveyed to the bony structure of the skull, and in the above photo this is done through the agency of the hat.

The photo at the left shows a novel monorail car which can travel at a speed of eighty miles an hour. It is planned to use this in the new tube which is to be built under the river Tyne in England, linking the towns of North and South Shield. The power is obtained from the wheels and the rail overhead. The gyroscope may be seen under the center of the car.

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Will There Be

By DR. GENE
PROFESSOR O

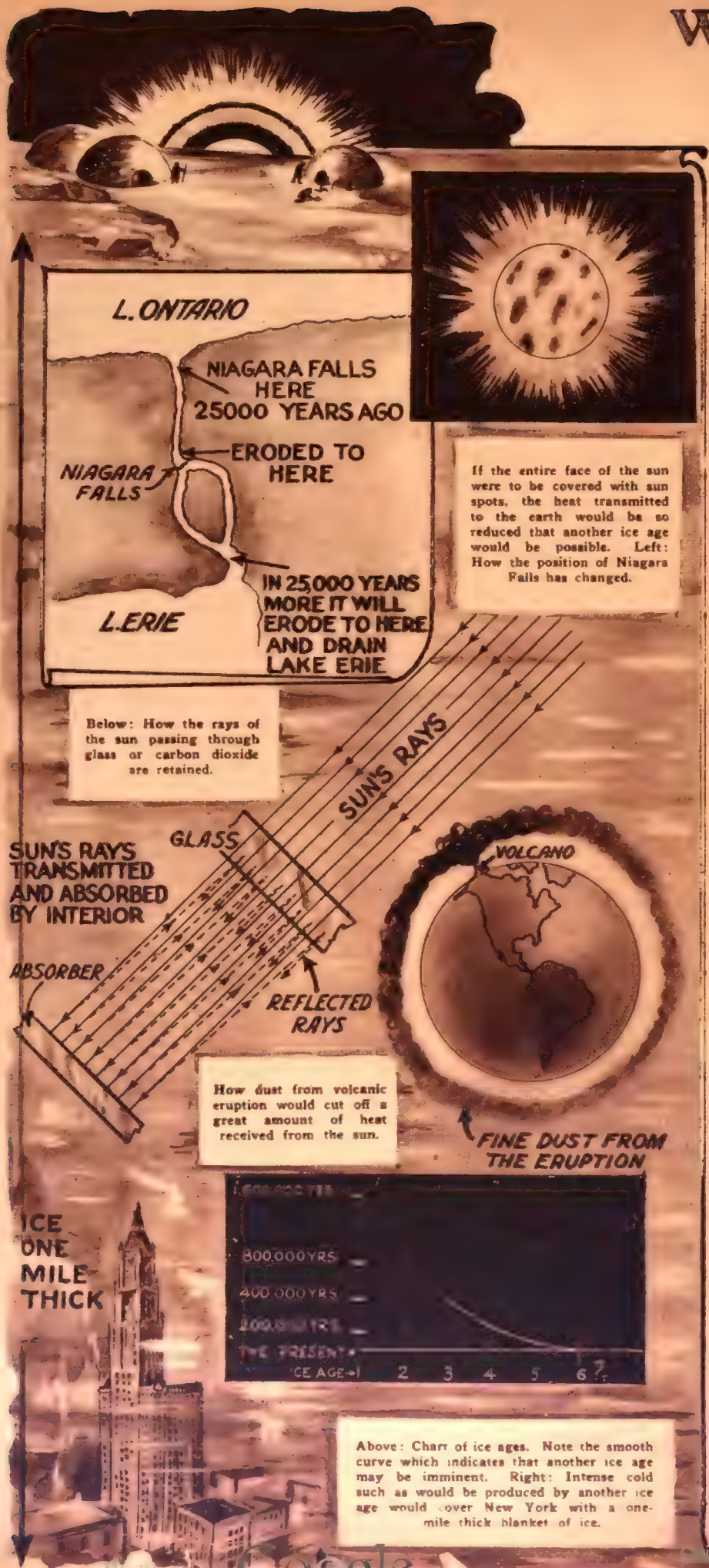
THE recent return of Dr. Donald B. MacMillan, the well-known arctic explorer, who reports that the depth of ice in Greenland is increasing, brings up the question of whether or not we shall have another ice-age.

Geologists tell us that five times in the history of the earth an ice-sheet has crept down from the North Pole and covered the North American Continent. The dates of these can only be fixed approximately, but it is likely that the first occurred some 1,600,000 years ago, followed by others at intervals which were halved at each recurrence—800,000, 400,000, 200,000 and 100,000 years. It appears that the next age of glaciation should take place about 50,000 years after the last.

When the last sheet of ice that overspread the American continent was retreating, it left a new path for the water from the Great Lakes or Lake Erie to flow to the St. Lawrence. That path lay along what is known as the Niagara River. Now when this new river started flowing, it had a fall at the entrance to Lake Ontario. Since that time it has been eroding back toward Lake Erie. Since it started at the time the ice-sheet was passing that point, if we calculate the average backward erosion per year and divide it into the distance between this point and the present location of the falls, we will obtain the time which has elapsed since the ice-sheet was on that spot. The actual erosion took probably 25,000 years and to this must be added 20,000 to 30,000 years for the period of retreat of the ice-sheet before it reached the Niagara River and enabled it to start running. The total time, therefore, since the last age is 45,000 to 55,000 years. It appears that another ice-age may be due in a very short time, geologically speaking. However, there is at the present time no need for the general public to become alarmed at this prospect. Such a phenomenon will probably not occur within the lifetime of the present generation or even of several generations to follow. Time expressed in geographical terms as being short usually means a thousand years or more. In the life history of this little earth of ours, a mere thousand years is but as a minute in the lifetime of a human being.

The causes of the ice-ages are very obscure. It has been suggested that our sun may occasionally become almost totally covered with the spots which are often visible upon its surface. This would so reduce the amount of heat radiated that ice would immediately form on the earth.

Another explanation may be found in the possible change in the composition of our atmosphere. The temperature inside a greenhouse may be quite comfortable even when it is freezing without. The glass allows the sun's heat to come in, but will not allow the re-radiated energy to escape. Carbon dioxide and water vapor in our atmosphere act like glass in a green-house. If, for some reason or other, the quantity of this were halved, another glacial period would occur. On the other hand, an increase of only three times the amount would produce so mild a climate that magnolias could grow in Greenland. A diagram showing the passage of the sun's rays through glass is given at the left. The rays first pass through the glass and are then partially absorbed and partially reflected by the interior. These reflected rays are again turned back by the glass and a great amount of heat results.



If the entire face of the sun were to be covered with sun spots, the heat transmitted to the earth would be so reduced that another ice age would be possible. Left: How the position of Niagara Falls has changed.

Below: How the rays of the sun passing through glass or carbon dioxide are retained.

How dust from volcanic eruption would cut off a great amount of heat received from the sun.

Above: Chart of ice ages. Note the smooth curve which indicates that another ice age may be imminent. Right: Intense cold such as would be produced by another ice age would cover New York with a one-mile thick blanket of ice.

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Another Ice Age

DEACHEM
ASTRONOMY

FINE volcanic dust suspended in the atmosphere would form a cloud through which the sun could not easily shine. Such dust, even from a small eruption, has caused a marked local effect in temperature even on opposite sides of the earth from the volcano. There is a possibility that an extended eruption of a large volcano might cause glaciation. The illustration on the opposite page shows how a tremendous volcanic eruption, which by the way is not entirely impossible, could cause a blanket of volcanic dust to be thrown around the earth and distributed in our atmosphere. Such a blanket would, of course, cut off a great amount of heat from the sun and consequently produce the effect mentioned.

A suggestion, often made, but with little foundation, is that the earth's axis may have shifted its position, causing the North Pole to lie nearer the center of the ice-capped region. It is more difficult, however, to find a force capable of moving the pole than it is to explain the ice-age on other grounds. In view of recently learned and deduced facts, this suggestion may be dismissed in favor of more probable reasons for ice ages.

One of our illustrations herewith shows the effect of the ocean's currents on the distribution of ice. It will be noticed that the Gulf Stream so alleviates the climate that the polar ice-cap (shaded portion) extends only half as far from the pole in the direction of the warm current as it does on the other side. If the course of the Gulf Stream were changed to flow up to the coast of America, the climate of Greenland would approximate that of England, while the British Isles would be no warmer than Labrador and in all probability the side of the polar cap nearest to Greenland would recede still further toward the pole. Thus we can see that the warm currents in the sea have a great effect upon the temperature of the surrounding land.

Attention should be called to the fact that man has existed throughout this time, as some human remains have been found in deposits between the last glacial periods. There is some evidence that the last glaciation may have been very rapid. Several specimens of mammoths, caught in the drift, were frozen, and their flesh so preserved by this natural refrigeration that it is reported on one occasion that it was eaten by the dogs of the party. This is illustrated in the lower right-hand corner of this page. The explorers connected with a northern expedition were hard put to keep their sledge dogs away from the remains of the mammoth so that the animal's body could be exhumed from its natural resting place and preserved in its entirety for future study and exhibition. The flesh of this particular mammoth was as well preserved by the action of the ice as if it had been freshly killed.

It is really correct to say that the poles are still in the midst of the last ice-age for the evidence is complete that the North Pole was, at one time, almost a tropical region. Corals and plant fossils are found in Greenland. Huge deposits of coal, which are only formed by luxuriant growths, have been found in Spitzbergen, as indicated herewith. Coal is even found in Grantland, at a distance of about 500 miles from the pole. It is a well-known fact that coal deposits are formed by the decay of vegetable matter which in turn is covered over by soil and so compressed. Coal deposits indicate former luxuriant vegetation.

A change of the gulf stream toward Greenland would give that country a tropical climate.

How a shift in the position of the pole would cause glaciation. Old possible position of pole marked.

Right: Coal deposits indicate former tropical climate. Below: the extent of the last ice age.

Former ice sheets must have descended quick-

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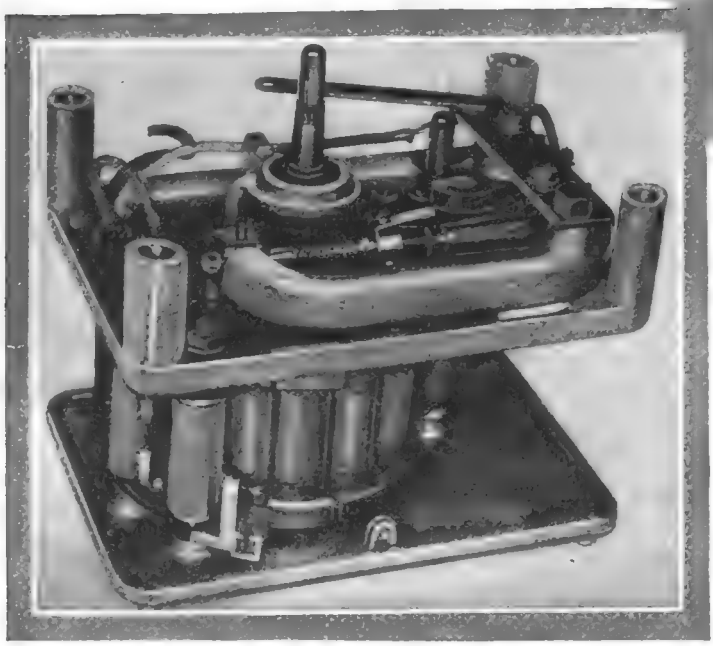
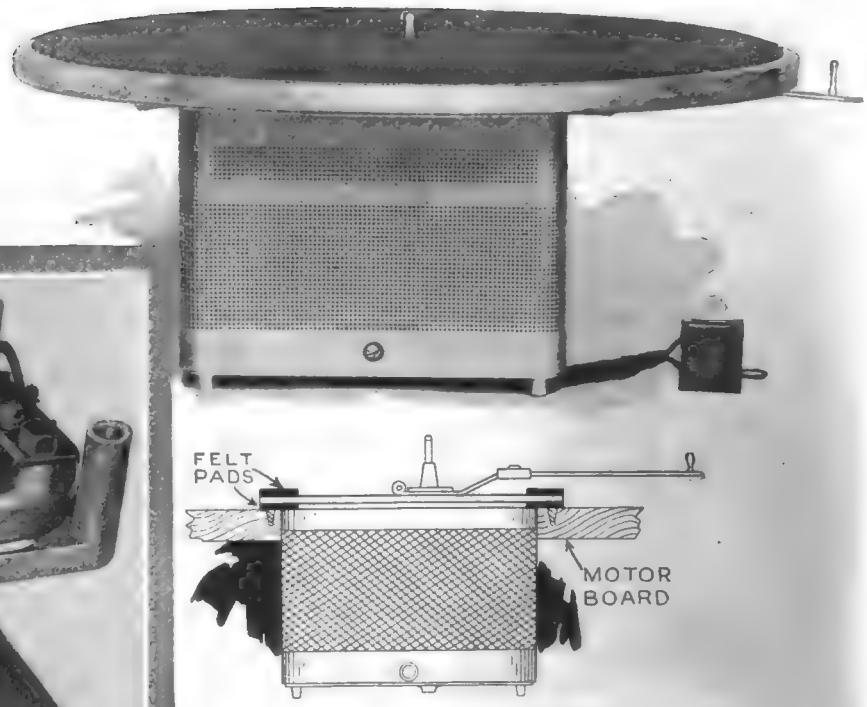
Electric Phonograph Motor

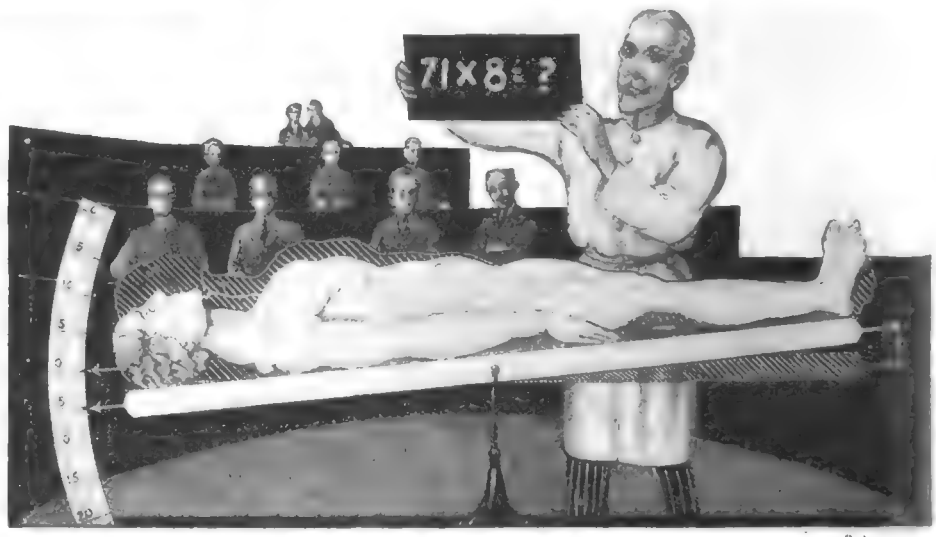


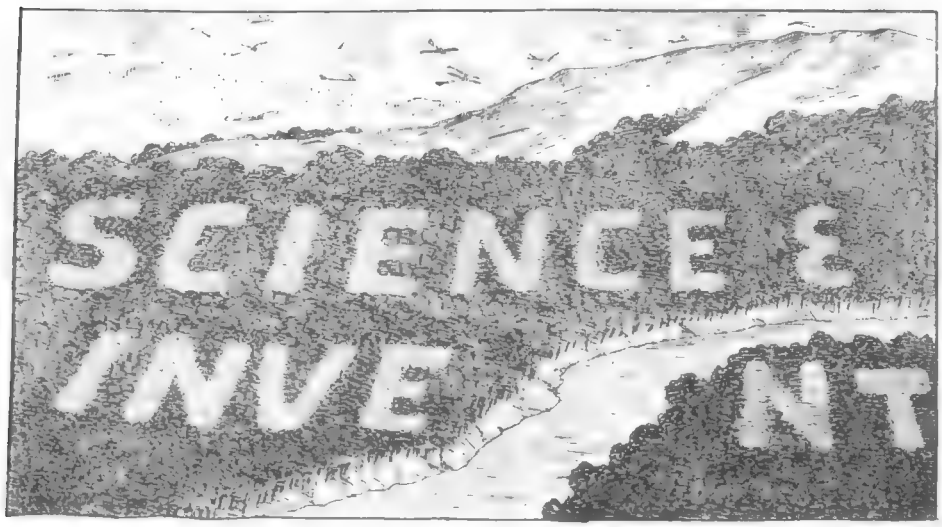


The very latest in phonograph motors is a new instrument being manufactured by a New York concern, which aside from being built on the same principles as the ordinary electric motor, runs at a constant speed of approximately seventy revolutions per minute. There is no gearing or belts of any kind, the shaft of the motor being directly connected to the phonograph turn-table. The motor is so wired that changes of ten volts in the supply does not affect the speed.

Thought Needs Blood

That an extra supply of blood is needed, when the brain works, has been very graphically shown by some German physicians and recorded in *Kosmos*. The patient was placed upon the pivoted table and brought to a balance. Then while resting peacefully he was suddenly confronted with a problem and asked for the solution of it. Immediately the mental energy began to be applied to the problem, the table showed a tilt indicating added weight at the head end. The only possible explanation for this change in weight is that an extra amount of blood rushes from the remainder of the body to the brain for assistance in the mental processes, thus increasing the weight.





Advertising of the Future

With the constant popularization and increase in aerial navigation, much thought is being given to the possibilities of advertising for the benefit of passengers of airplanes. The sketch at the left, the idea of Hubert Slouka, shows one of the many possibilities which will at once make themselves obvious. In this instance the product will be advertised—usually just its name—will be cut out of a wooded area. The contrast between the dark green wooded portions and the lighter cleared area will give ample contrast to the inscription written.

—Hubert Slouka.

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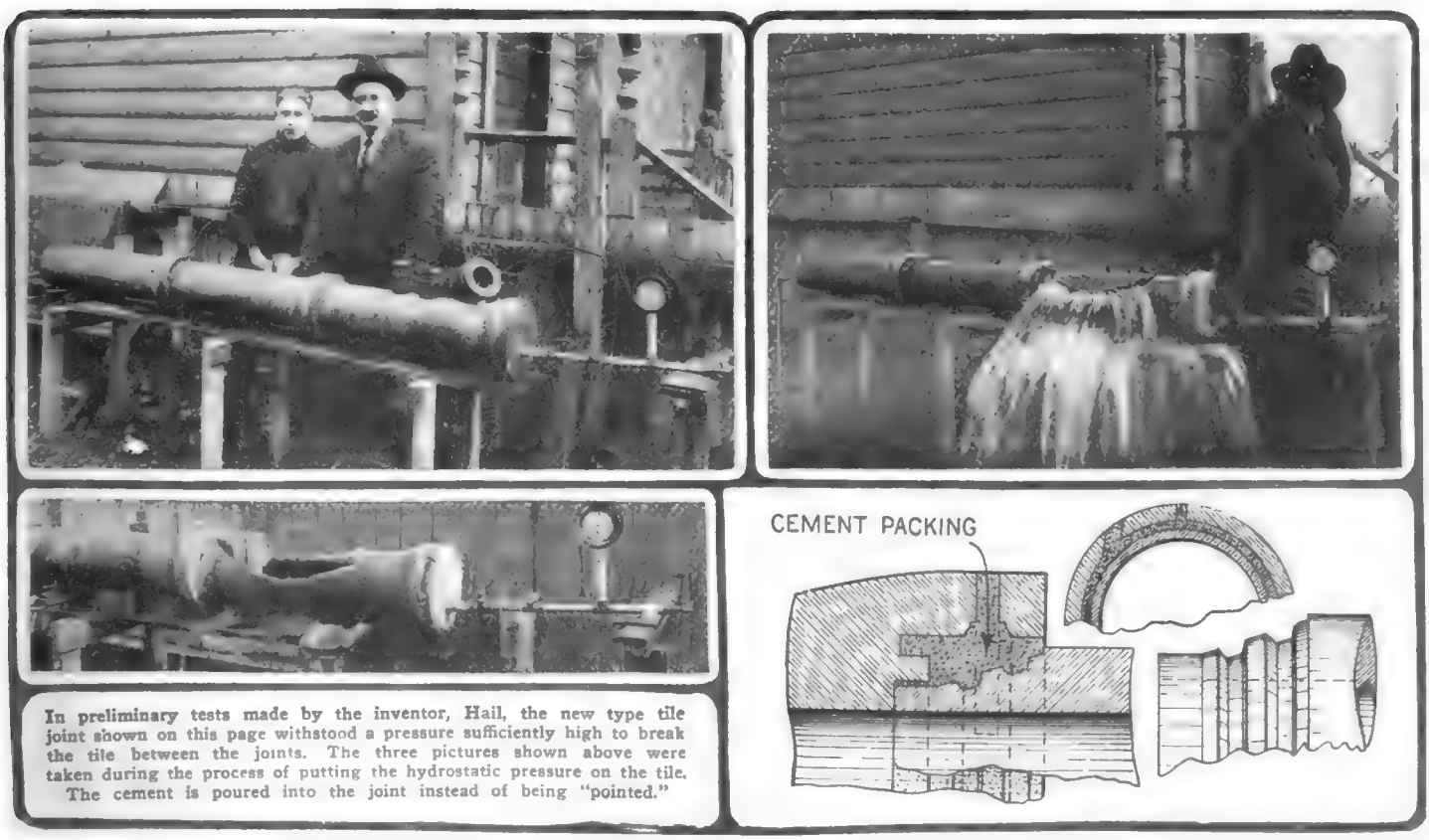
Artist's Copying Device

MANY times a copy is desired of some object such as a bust or piece of apparatus, which is irregular in contour and an accurate copy cannot be produced by ordinary drafting methods. The system given in the picture may be used to produce exceptionally life-like illustrations which could not be done through the regular methods. Through its use shadow effects and background may be put in with unfailing accuracy.

The screen A, is nothing more or less than a rectangular frame crossed by a number of threads stretched across it at given intervals. One set horizontal and one vertical, and parallel in each set. The standard B, provides a peep hole against which the artist places his eye and through which he observes the article being copied. The paper C, upon which he is making the copy, is lined off in squares proportional to those of the screen. By adjusting the size of the squares on the copying paper, the picture may be enlarged or made smaller than the original. —C. T. Stone.

New Tile Joint



In preliminary tests made by the inventor, Hail, the new type tile joint shown on this page withstood a pressure sufficiently high to break the tile between the joints. The three pictures shown above were taken during the process of putting the hydrostatic pressure on the tile. The cement is poured into the joint instead of being "pointed."

Almost all the previous difficulties in making tile joints have been eliminated in the new form of tile shown above. The spigot end has toothed projections, which the cement grips. The cement packing is poured in through a hole in the top of the bell end. The joint is extremely solid. —Gustav Hail.

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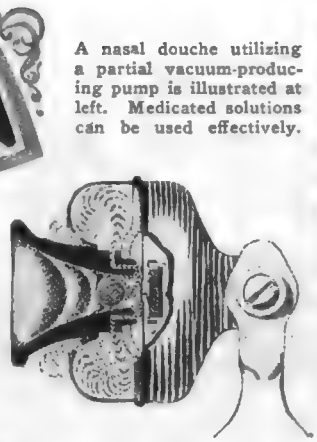
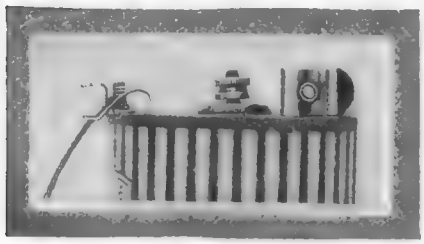
New Devices

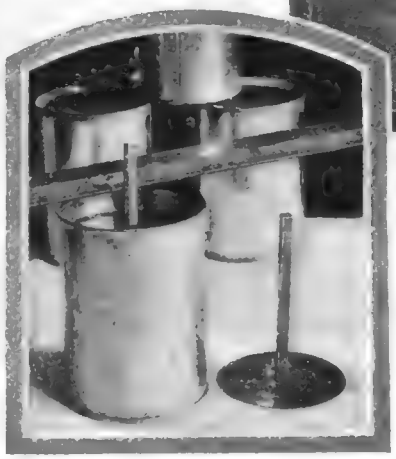
A nasal douche utilizing a partial vacuum-producing pump is illustrated at left. Medicated solutions can be used effectively.

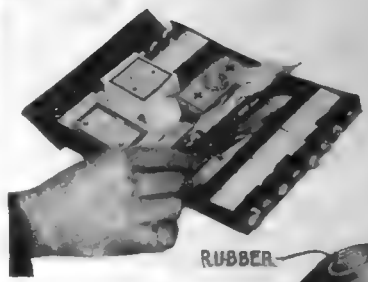


Right: A new type of private mouthpiece for telephone. Whispers will be transmitted using this mouthpiece. Below: binding post uses regulation screws.

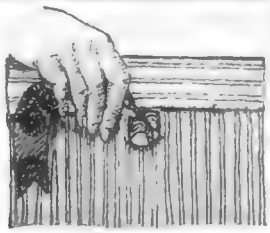
A new type of portable electric fan has been recently placed on the market that carries its own current supply. A small electric battery fits in the handle and drives the motor. This device is illustrated above. Left: A short strip of spring steel wire is designed to be placed over the door knob and slipped through the key as shown. This prevents the removal of the key and prevents picking of the lock. —Otto Halmer.







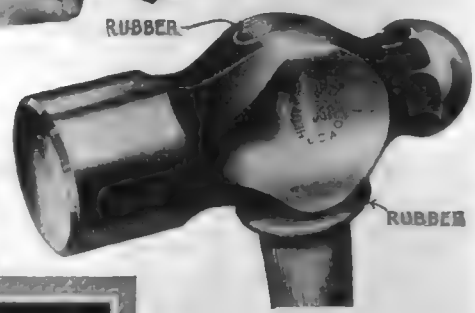
Left: A very compact yet complete first-aid kit specially designed for the use of motorists, campers and others where space is limited.

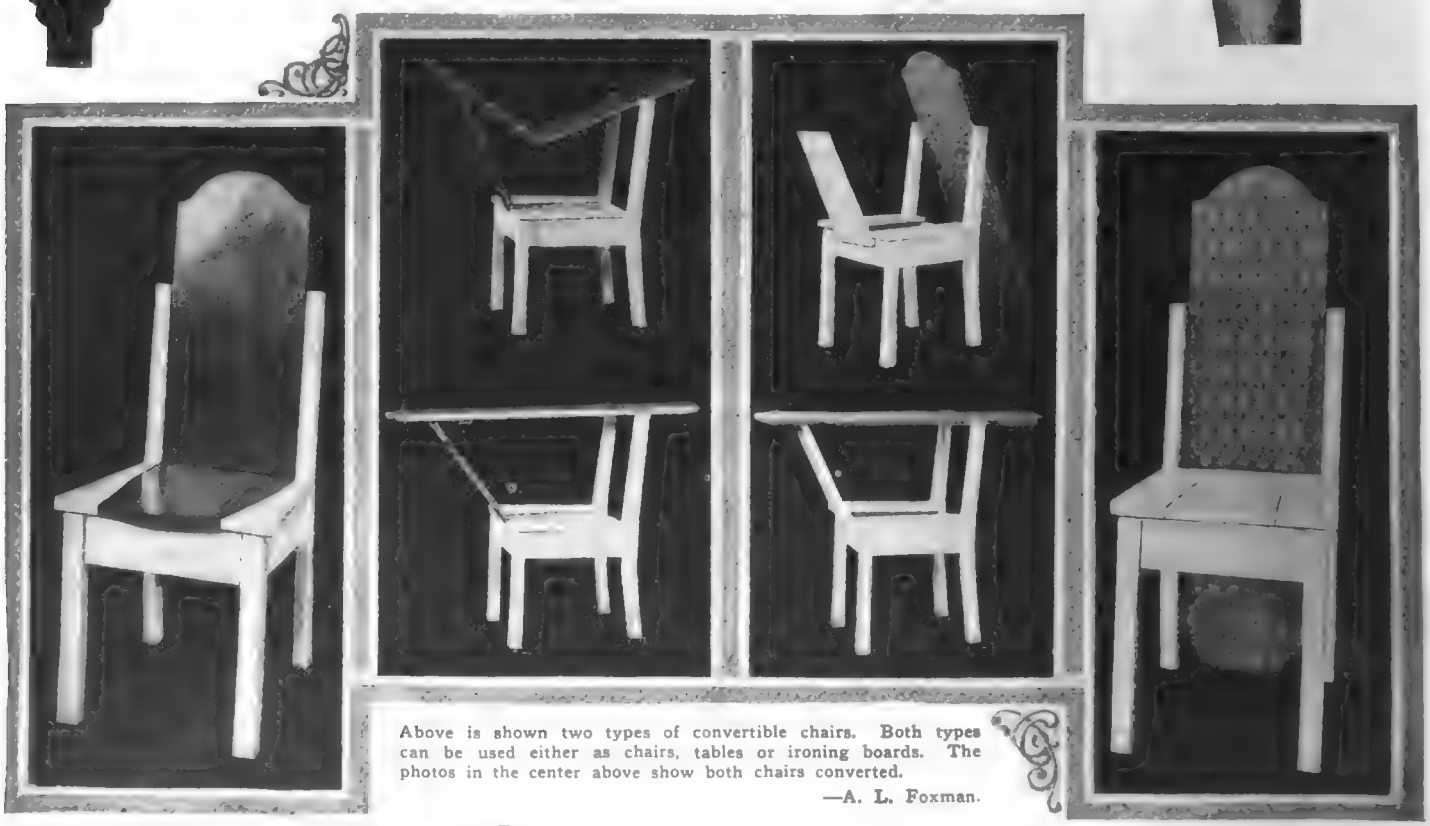


Above: The Neatrik, a new device for holding the watch securely in the watch pocket of a pair of trousers. Left: An automobile lock which is built into and is an integral part of the gear shift lever.

To determine the amount of liquid in a can of fruit or vegetables, the device illustrated above has been designed. The top is removed from the can and the circular disc of the device drilled with holes, placed on the material. It sinks until it rests on the solid material. —N. C. McLoud.

Right: A rubber insert in a hammer absorbs shocks of blows.





Above is shown two types of convertible chairs. Both types can be used either as chairs, tables or ironing boards. The photos in the center above show both chairs converted. —A. L. Foxman.

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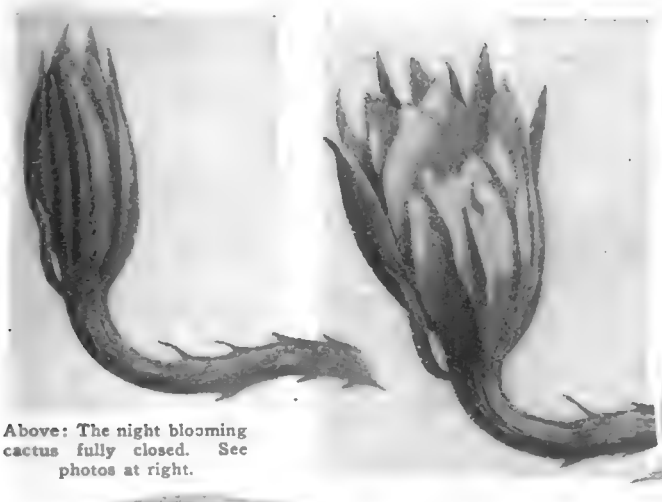
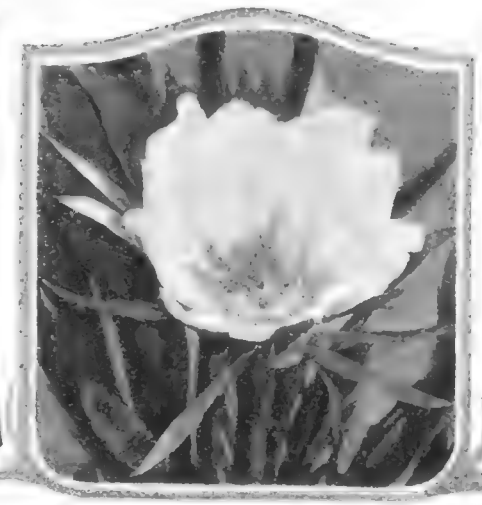
Studies of the Plant World

By S. LEONARD BASTIN

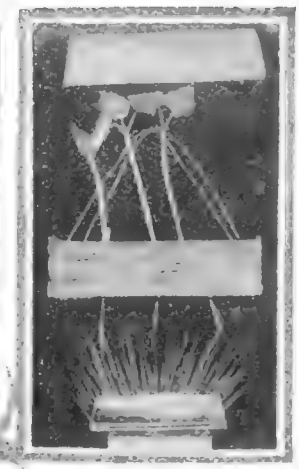


Above: The night blooming cactus fully closed. See photos at right.



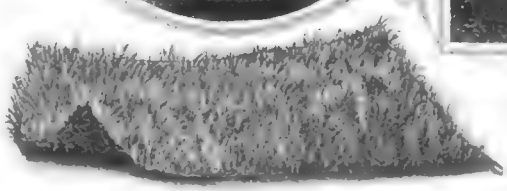
Above: The night blooming cactus photographed four seconds after the illustration at the right. Note how quickly it opened.

Above: Four more seconds have passed in the life of the cactus flower and now we see it fully opened in all its glory. Eight seconds from bud to full bloom is almost a record for flowers.



Do plant roots grow down to avoid sunlight? The mirror in the above photo would tend to prove that such is not the case.

Above: A novel decorative umbrella formed of growing roses. The stem of the plant was trained to grow up a straight stick, at the top of which was a wire frame in the shape of an umbrella. Reaching this, the plant spread out with the effect shown.



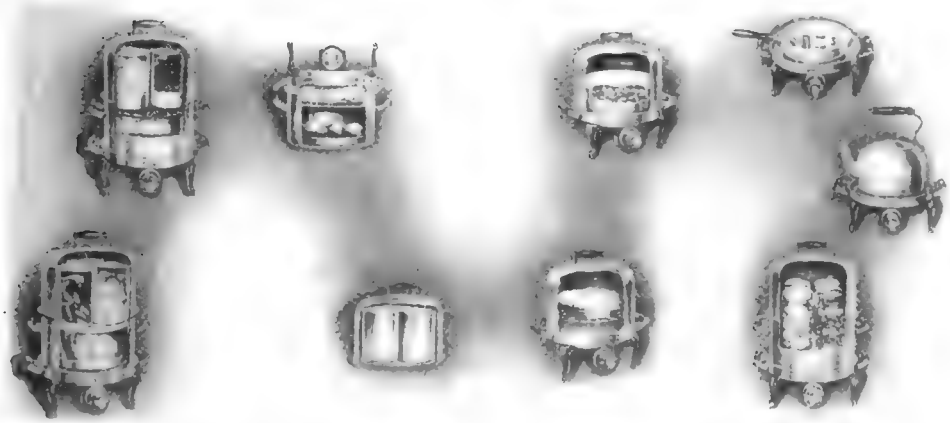
Left: A grass mat. Grass seed is sewn thickly on a strip of burlap and freely watered. After the roots take hold, the mat may be removed.

A FLOWERPOT GARDEN

A SMALL garden that will provide much pleasure to its owner and that will take up a minimum of room may be made from a flower pot as shown in the photographs at the left. A large pot is selected and several two-inch holes are bored in the sides as shown, leaving about the same distance between the holes. They may be made with an ordinary wood bit, exercising a little care in the process so as not to break the pot or chip it badly.

Now secure some good, rich, fine soil and a few small stones. Place a layer of the stones on the bottom of the pot to insure good drainage and fill the remainder with the soil. Then the bulbs may be planted as shown, some in the top of the pot and some of them in the holes mentioned above. For early spring planting, crocuses are the best.

Electric Fireless Cooker



Above: The various uses to which a new fireless cooker employing electricity for heating can be used. From right to left, top row; roasting meat and cooking three vegetables; broiling steak and warming potatoes; stewing and frying. Right center: boiling. Lower left to right; pot roasting and cooking three vegetables; warming vegetables; baking and cold pack canning. —J. W. Von Stein.

Gasoline Saver

The automobile accessory illustrated above heats the vaporized gasoline before it enters the cylinders, causing more complete combustion.

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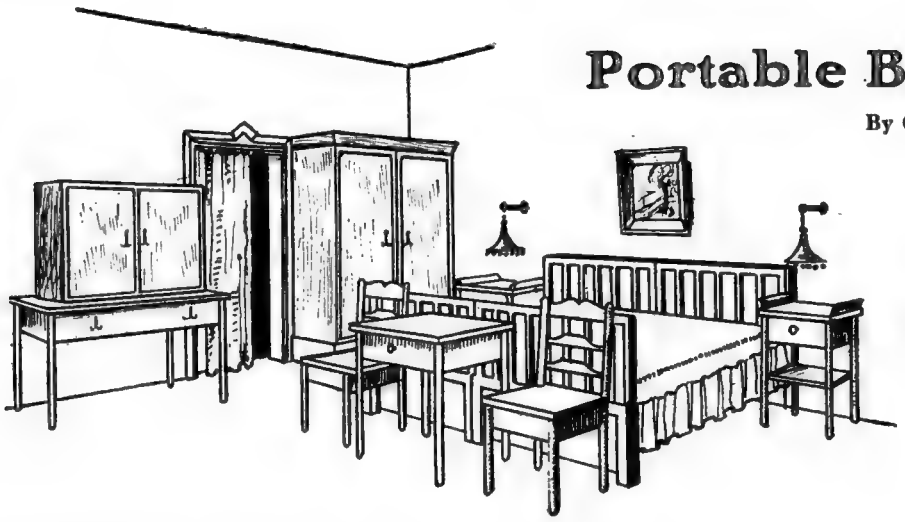
Portable Bed-Room Outfit

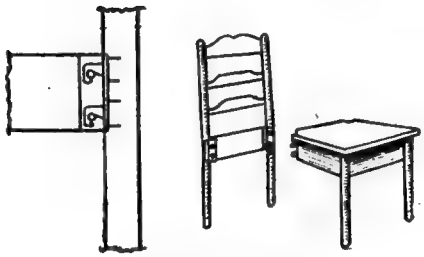
By G. H. WAETJEN



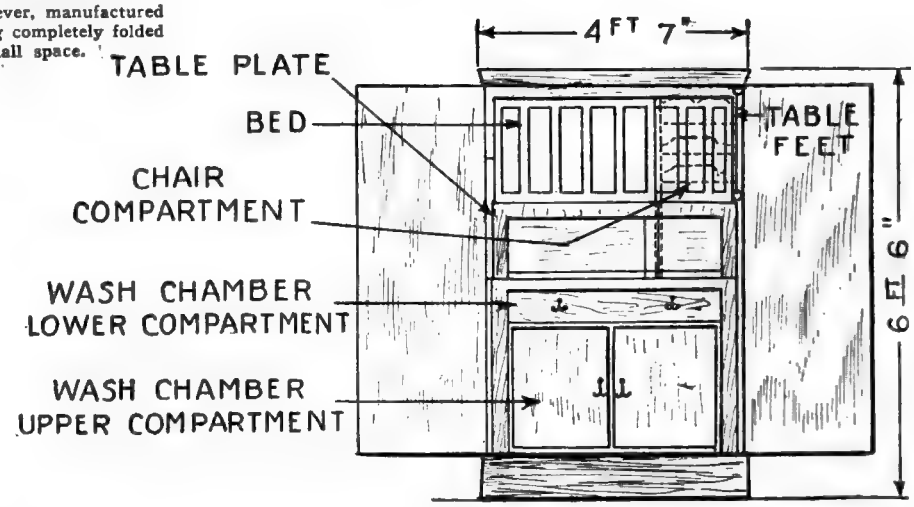
— THE ROOM OPENED UP —
CLOTHES-CLOSET
WASH-CABINET
BED (ACCOMODATING 4 PERSONS)
NIGHT-TABLE
TABLE
CHAIRS

THE FOLDING ROOM OPENED, READY TO LIVE IN.

The illustration directly above shows what appears to be an old fashioned bed-room suite constructed from solid oak and complete in every detail. This suite, however, manufactured by an Austrian concern, is capable of being completely folded and fitted together in a very small space.

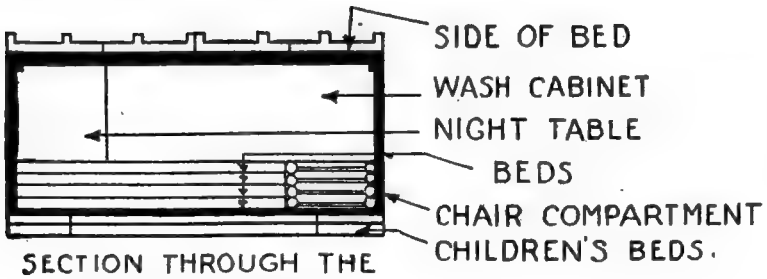


THE CHAIR



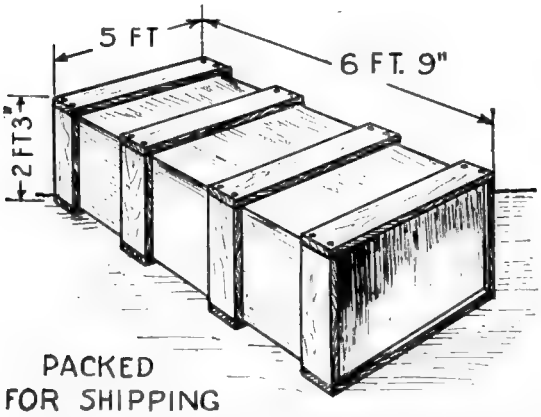
THE CLOTHES-CLOSET OPENED, SHOWING FURNITURE INSIDE

Above is shown how all of the furniture comprising this bed-room suite fits into the clothes closet after having been disassembled. The illustration to the left indicates the method of fastening the parts of the various pieces of furniture together. When assembled, the articles are very rigid and look exactly like ordinary furniture.



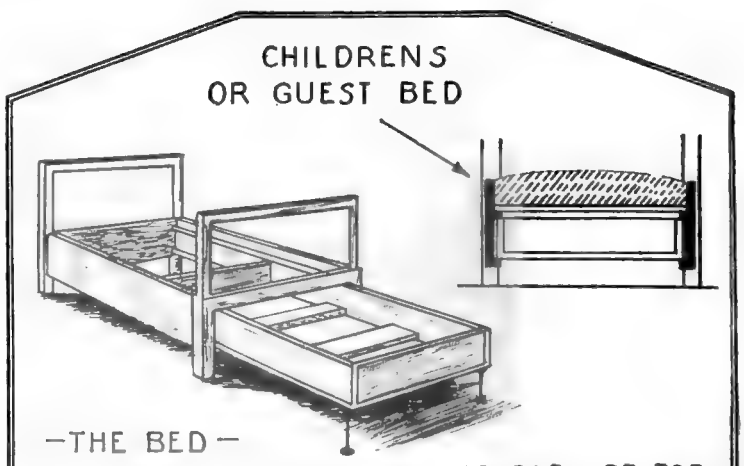
SECTION THROUGH THE CLOTHES-CLOSET

A side section view of the clothes closet is shown above. Note how each section of each piece of furniture fits in a definite place. The entire suite when so folded and packed for shipment occupies the dimensions given below.



PACKED FOR SHIPPING

THE WHOLE ROOM ENCLOSED IN THESE DIMENSIONS



—THE BED—

PROVIDING ROOM FOR TWO PEOPLE; OR FOR CHILDREN OR GUESTS

When guests arrive, sleeping space for two additional people may be provided by the auxiliary beds that are enclosed within the regular bed as shown above. This extra bed is only four inches smaller than the other.

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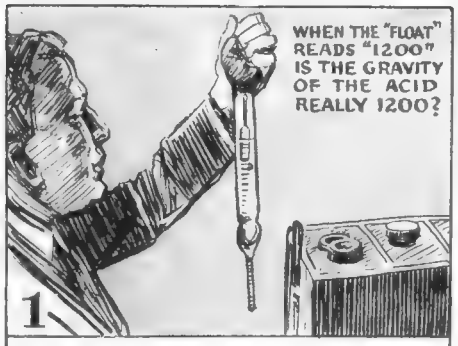
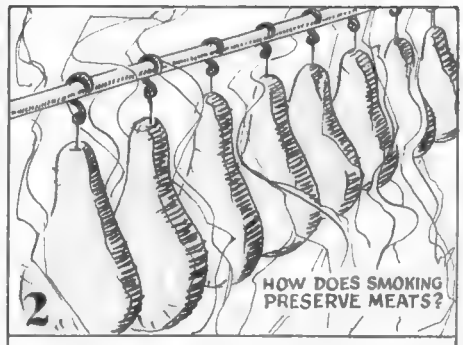
Everyday Chemistry

By RAYMOND B. WAILES



A hydrometer reading of 1200 means 1.200 or that solution is one and two-tenths as heavy as water. Eliminating the decimal point makes the scale somewhat easier to read.

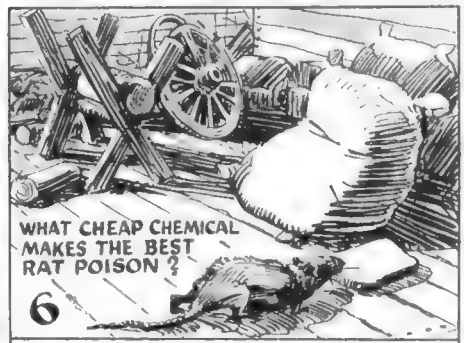


Various tarry products, among them being creosote, are distilled from woody materials when burned in insufficient air and they have a germicidal effect on meats.

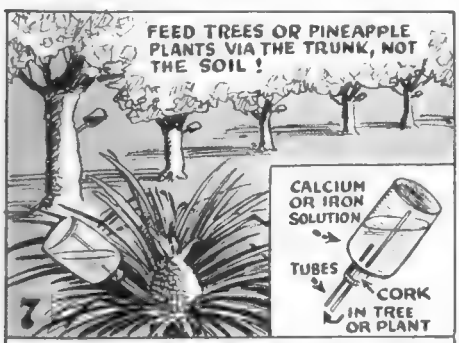
No one. Aspirin is a distinct chemical product just as sugar or salt, and is the same regardless of who makes it. It is not a mixture or blend that requires skill.

Iron is found in impure clay, but the characteristic metal which is there and in great quantities is aluminum. Commercially, aluminum is usually obtained from the mineral bauxite.

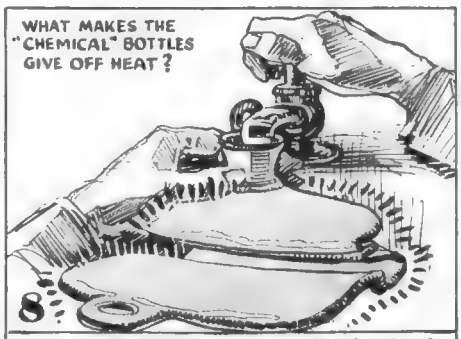
The carbon in India drawing ink is in a "colloidal" or unfilterable form. The particles are so small that they are actually suspended in the liquid, and therefore do not settle.



Barium carbonate or powdered witherite, a mineral, makes one of the best rat poisons. The material is very cheap when purchased at chemical supply houses and is easily used.

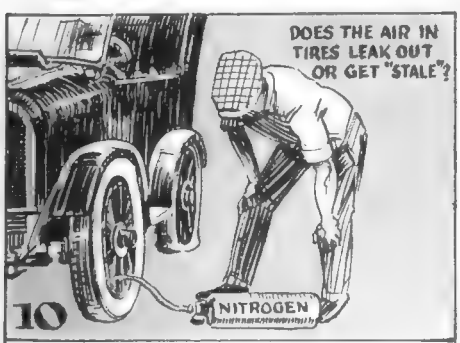


Instead of fertilizing the soil, certain species of trees can be fed through the trunk and in the case of pineapple plants through the leaves. Mixture of fertilizers and water is used.

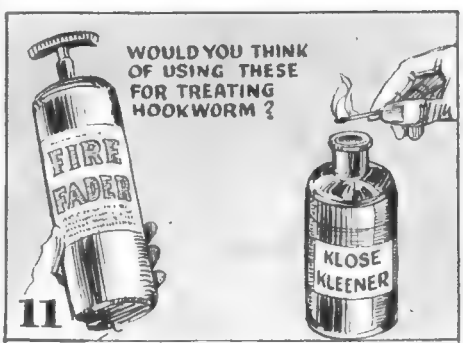


Because metallic iron powder, a bit of salt and manganese dioxide when moistened become chemically active. The iron rusts and gives off heat, while the salts hasten the reaction.

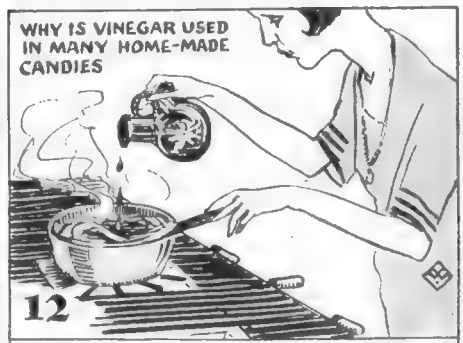
Carbon disulphide is a liquid which gives off a nauseating odor due to impurities contained in the commercial product. Several drops of this liquid poured into rat holes which are then plugged will eliminate the animals.



British engineers have found that tires filled with inert nitrogen gas seem to stand up longer than air filled tires. Possibly the air "does" get stale or leak out.



Carbon tetrachloride which is used in both non-inflammable cleaning fluids and fire extinguishers is being employed with success in combating hook worm disease.



Because acids such as that in vinegar convert cane sugar into invert sugar, which is creamy in consistency when near hardness and aids the appearance of candy.

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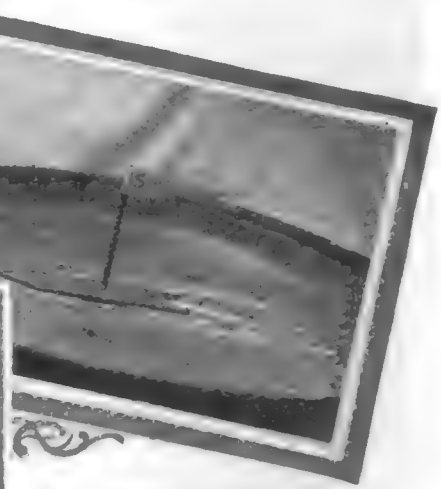
Surface Tension-Capillary Attraction-Cohesion

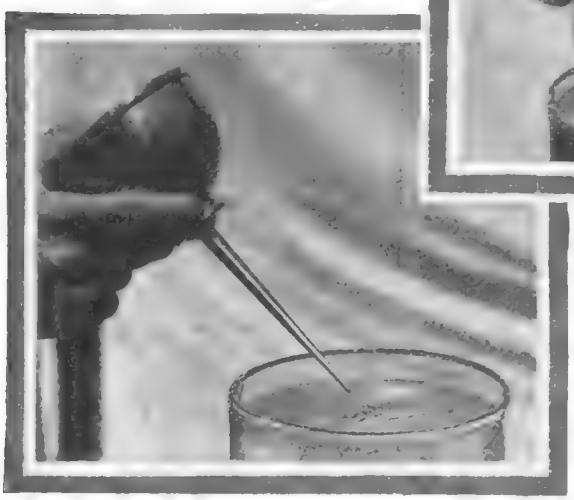
Capillary attraction. Use two pencils which have been cleaned from grease and wet them with water. If placed side by side, one will support the other as shown below. Water holds them together by its surface tension.

Two strips of paper bent as shown at the left will immediately come together and form a single strip if several drops of water are poured between their faces. Here again, surface tension is the cause.



Right: Capillary attraction will cause water to rise between glass plates in a hyperbola.

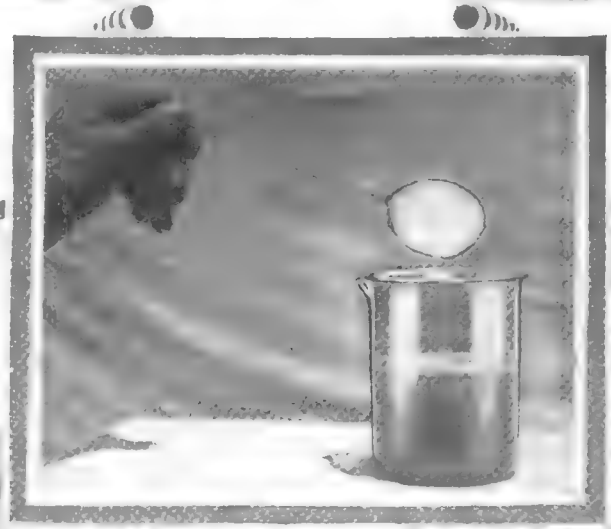
Due to surface tension, a bit of camphor will propel a light toy boat as above.



Left: Float a match on water. A drop of oil placed near it will cause the match to move due to surface tension. Right: Capillary attraction causes water to rise higher in a small tube than in one of larger bore. Dip the tubes in water and then almost withdraw them.

Cohesion may be likened to capillary attraction without the medium of a liquid film. To demonstrate, cut an inch length of solder from a stick of the same, file the ends blunt and even and press the ends firmly together. They will adhere to each other.

A soap film will form across a ring of wire when the latter is dipped into soapy water and withdrawn. The surface tension between the water and the wire causes this formation, the force occurring around the entire ring. The wire might also be in square formation.



Oil will spread on the surface of galena but water will not. Pulverized ore is separated from sand by whirling it in a container with oil and water. Upon standing, oil will rise to top carrying ore with it.

—Raymond B. Wailes.

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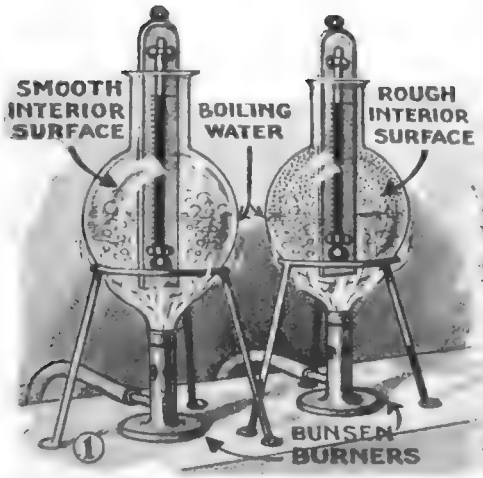
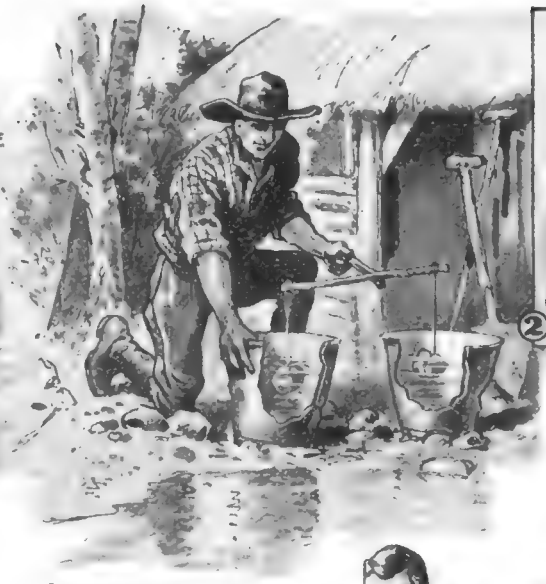
Scientific Problems and Puzzles

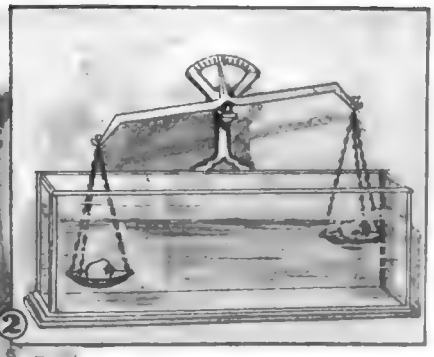
By ERNEST K. CHAPIN



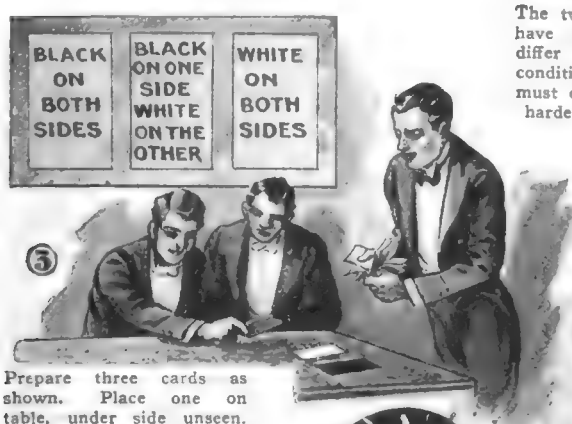
Under the conditions illustrated above, will both thermometers read alike?



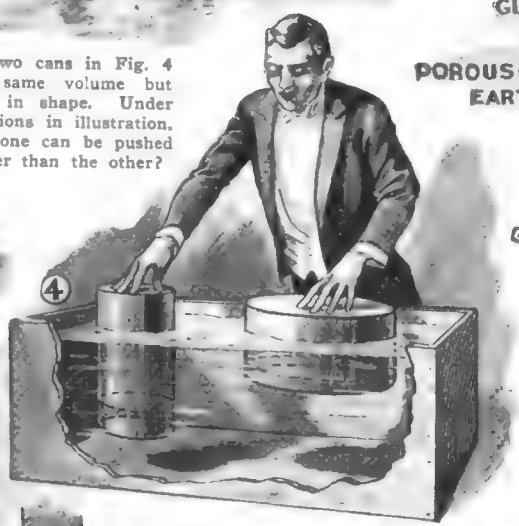
The two cans in Fig. 4 have same volume but differ in shape. Under conditions in illustration, must one can be pushed harder than the other?

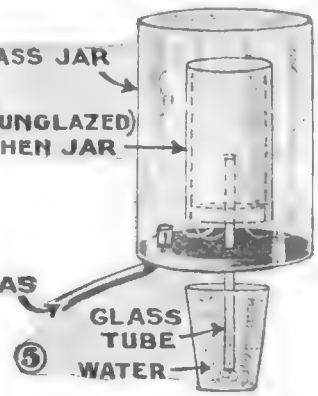


How can a prospector having no other facilities for testing, determine whether a supposed nugget is of pure gold when another nugget known to be of pure gold is at hand?

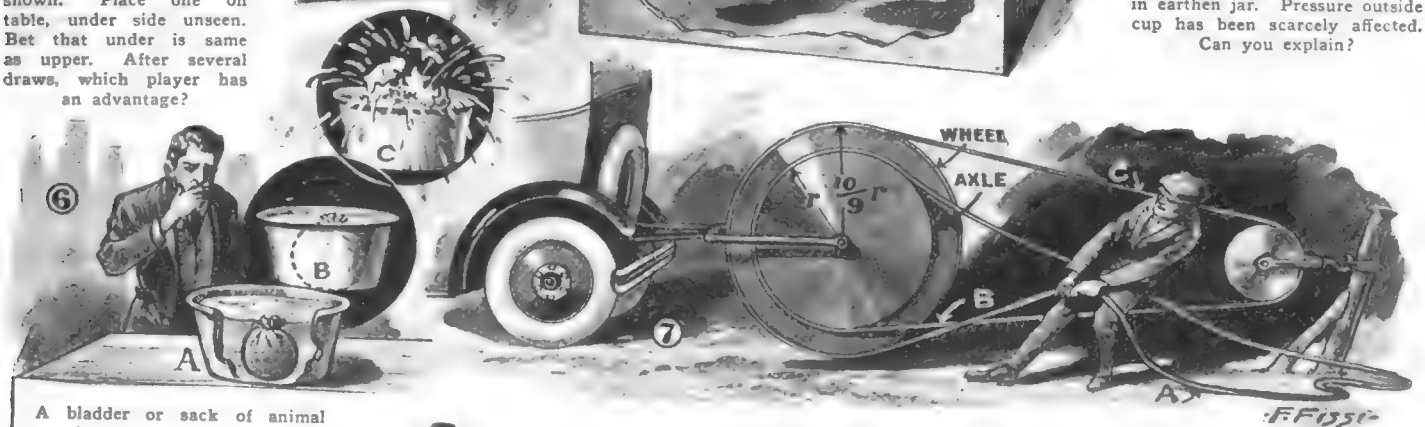


Prepare three cards as shown. Place one on table, under side unseen. Bet that under is same as upper. After several draws, which player has an advantage?



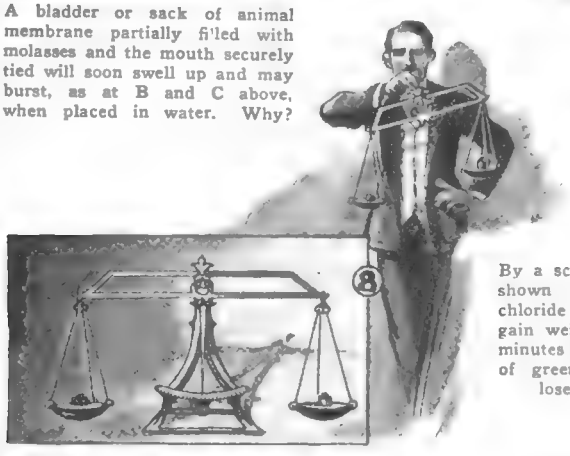


When illuminating gas is passed into the glass jar as in Fig. 5, bubbles issuing from glass tube will indicate increased pressure in earthen jar. Pressure outside cup has been scarcely affected. Can you explain?

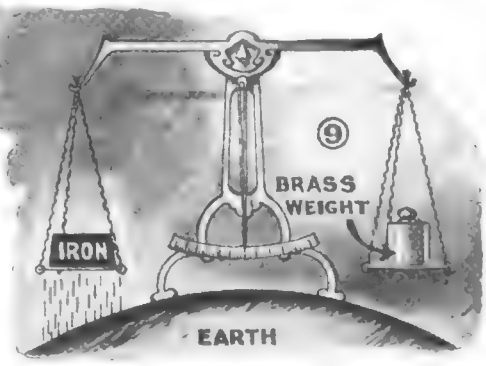


A bladder or sack of animal membrane partially filled with molasses and the mouth securely tied will soon swell up and may burst, as at B and C above, when placed in water. Why?

With two wheels as above, both on same axle, but fastened together, what force will be applied to car by 200 pounds pull on rope A?



By a scale, it can be shown that calcium chloride in air will gain weight in a few minutes while crystals of green vitriol will lose. Why?



Assume a large scale as illustrated at left in Fig. 9. A block of iron is balanced by a brass weight. Will it be found that the magnetic field of the earth will make the iron object greater in weight than the brass one?

(*Answers given on page* 1256)

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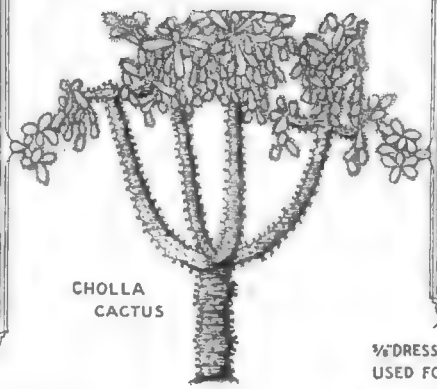
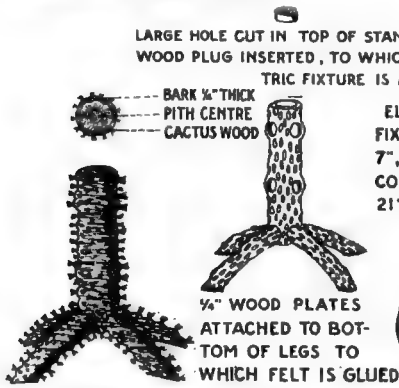
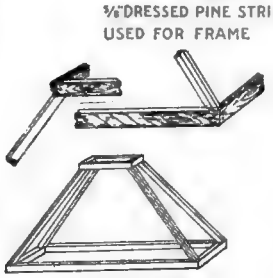
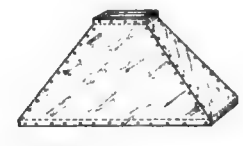
THE CONSTRUCTOR

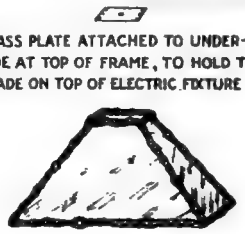
Making Cactus Lamps




LARGE HOLE CUT IN TOP OF STAND AND WOOD PLUG INSERTED, TO WHICH ELECTRIC FIXTURE IS ATTACHED
BARK ¼" THICK
PITH CENTRE
CACTUS WOOD
ELECTRIC FIXTURE IS 7", STAND COMPETE IS 21" HIGH
¼" WOOD PLATES ATTACHED TO BOTTOM OF LEGS TO WHICH FELT IS GLUED

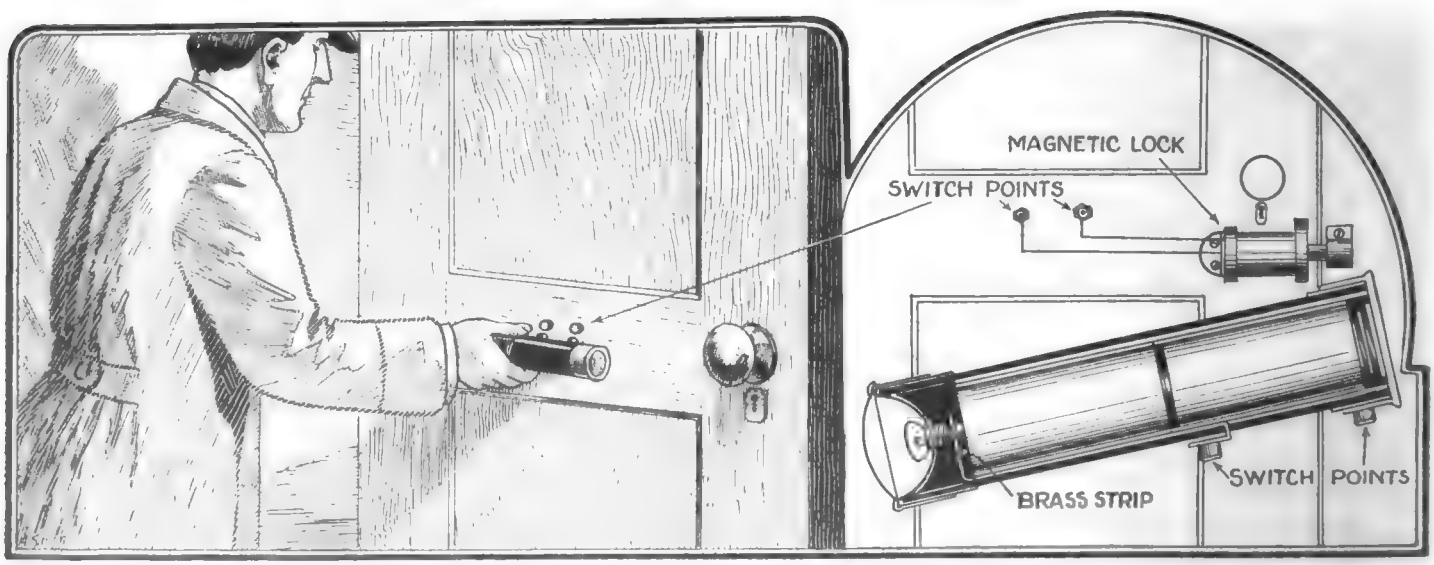






The above photographs and drawings show how the Cholla cactus can be made into a very beautiful and novel lamp. In the upper left-hand corner is a photo of the finished lamp, made by the author. Parchment paper stretched across the corners of the shade frame and then painted with natural scenery, some of which is shown in the upper right-hand photograph, makes a very effective and attractive lamp. First, a piece of cactus is cut off as illustrated in the top center diagram. The bark is then entirely removed but care must be exercised, so that the spines do not get into the skin. When the bark comes off, the wood appears to be very knotty. After all of the pith has been removed the wood is full of holes. The top of the frame is now hollowed out and plugged for the electric light fixture. The stand is stained and rubbed down. Meanwhile a frame is constructed as indicated in the diagram, and covered with parchment and painted. The edges of this frame are fitted with cactus trimmings and the whole makes a picturesque lamp.—Byron W. Sieg.

Magnetic Door Locks



By fitting a flashlight with two switch points, as illustrated at the right, and constructing a magnetically operated lock, the experimenter will have produced something rather unique; the door cannot possibly be opened by anyone unacquainted with the secret. Pressing the switch points upon two others mounted on the door, operates the solenoid and causes the bolt to be drawn into it, thus opening the door.—Philippe A. Judd, Reporter No. 7297.

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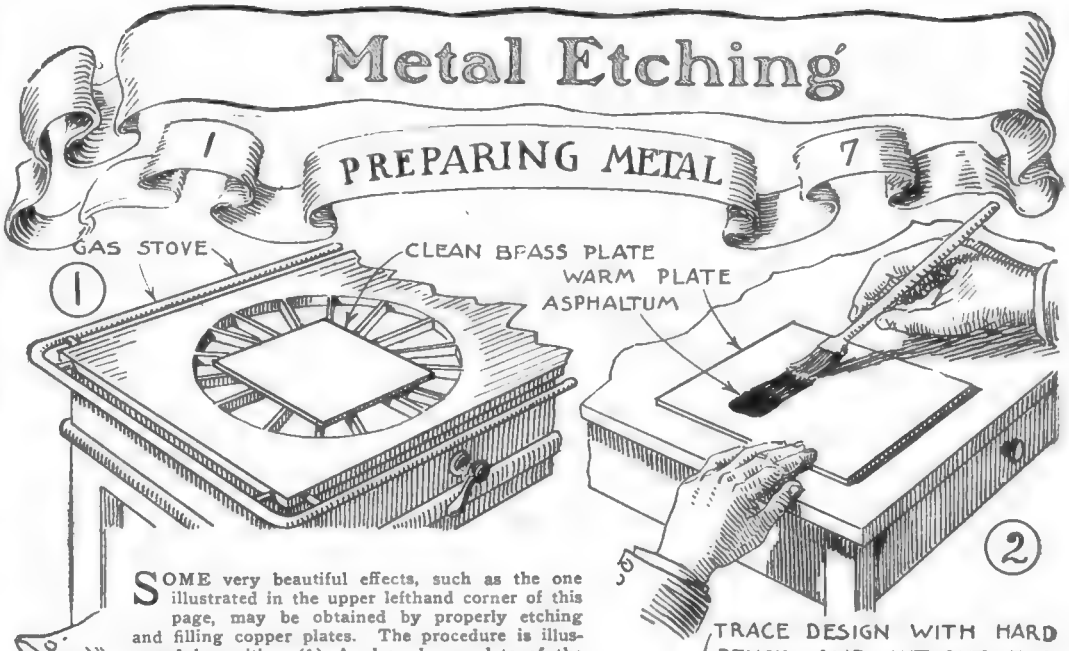
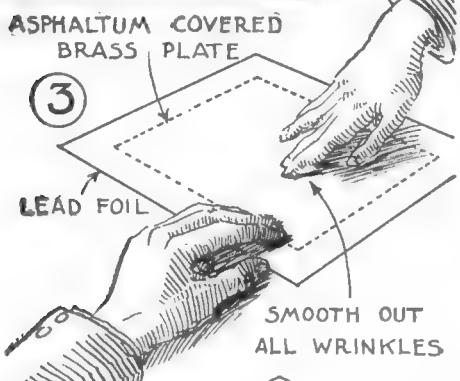
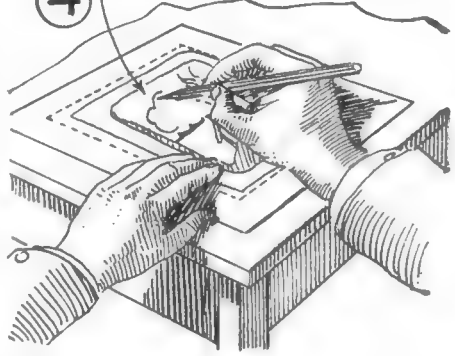
Metal Etching

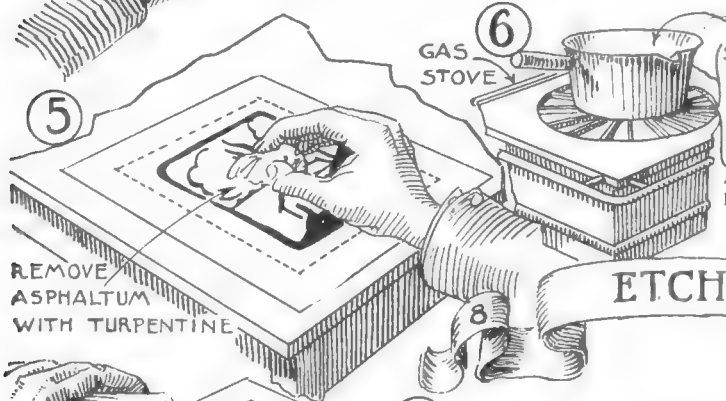
PREPARING METAL

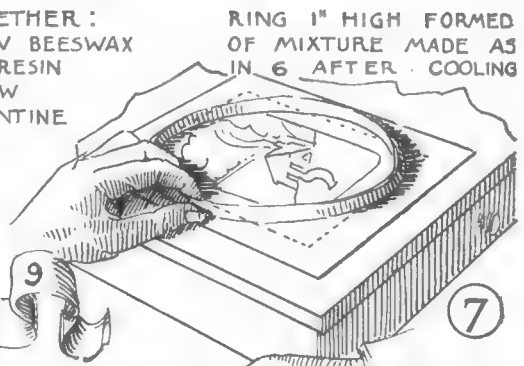


SOME very beautiful effects, such as the one illustrated in the upper lefthand corner of this page, may be obtained by properly etching and filling copper plates. The procedure is illustrated herewith. (1) A clean brass plate of the desired size is warmed over a gas flame and (2) coated with asphaltum. Then, (3) a sheet of lead foil is smoothed out over the brass plate and, (4) a design is traced on the foil and the parts to be etched are cut away with a very sharp knife. A cloth saturated with turpentine is then used to remove the asphaltum, (5). A composition is then made, (6) and a ring formed of the mixture around the part to be etched, (7). An acid solution (8) is then made up and poured into the space formed by the ring, care being taken that the plate is level. The acid is left on until the copper plate is sufficiently etched. This length of time must be determined by experiment. The acid is then washed off with warm water, the foil removed and the asphaltum taken off by moistening it with turpentine and scraping. The plate is then ready for the filling of the etched portion.

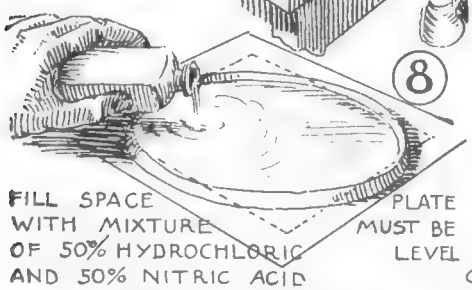








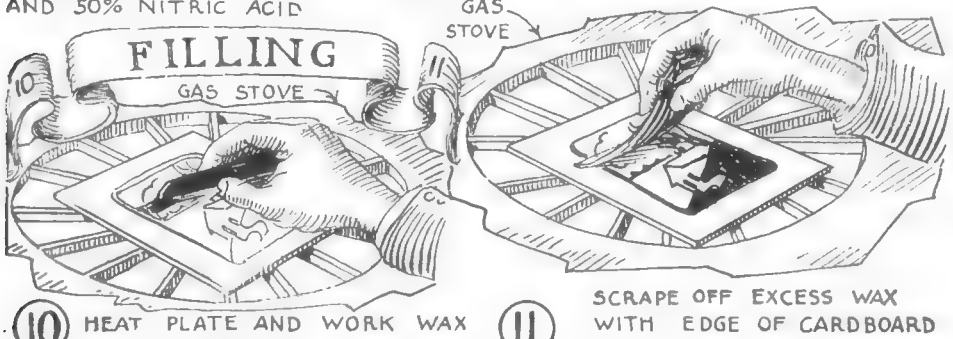
ETCHING



To fill the etched plate, heat it, (10) and work sealing wax into the design. In place of sealing wax, a filler composed of "patent dryer" thoroughly mixed with dry color may be used. Scrape off the excess wax, (11) with a piece of cardboard or preferably a flexible steel knife. A pleasing effect can be put on the plate (12) by covering the plate with etching solution, after which salt is applied and the surface thoroughly scrubbed.

—Joseph Crotty.

FILLING


10
GAS STOVE
11
GAS STOVE
10 HEAT PLATE AND WORK WAX INTO DESIGN
11 SCRAPE OFF EXCESS WAX WITH EDGE OF CARDBOARD OR FLEXIBLE KNIFE

FINISHING

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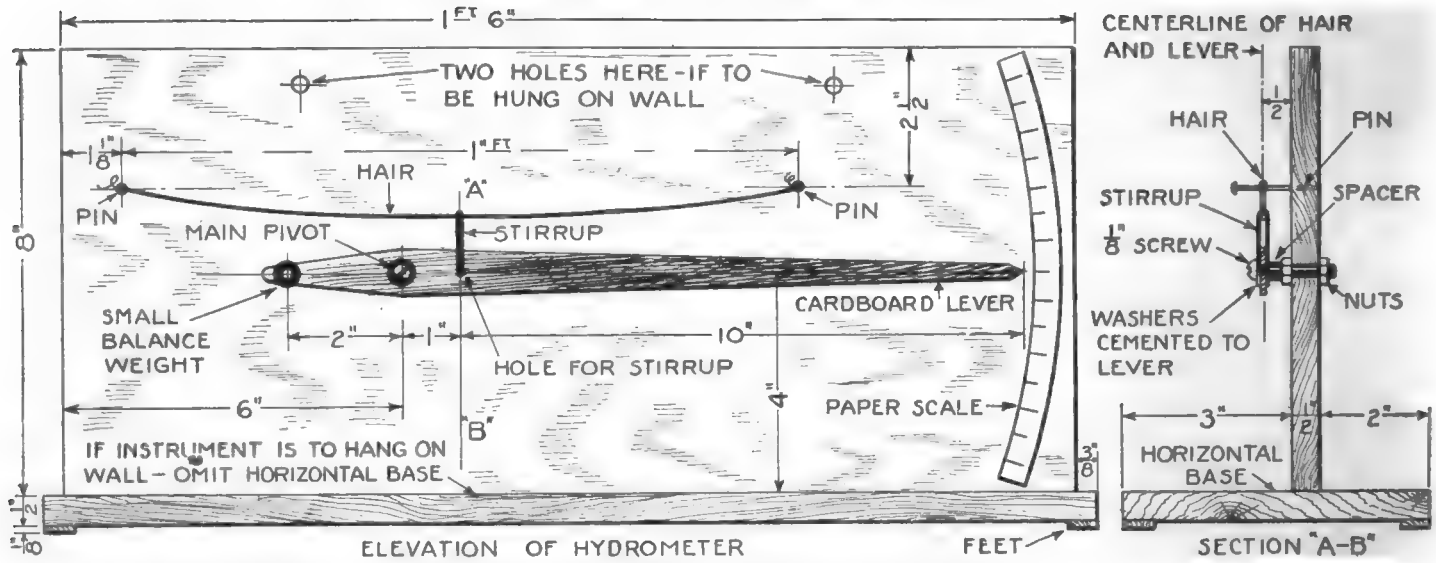
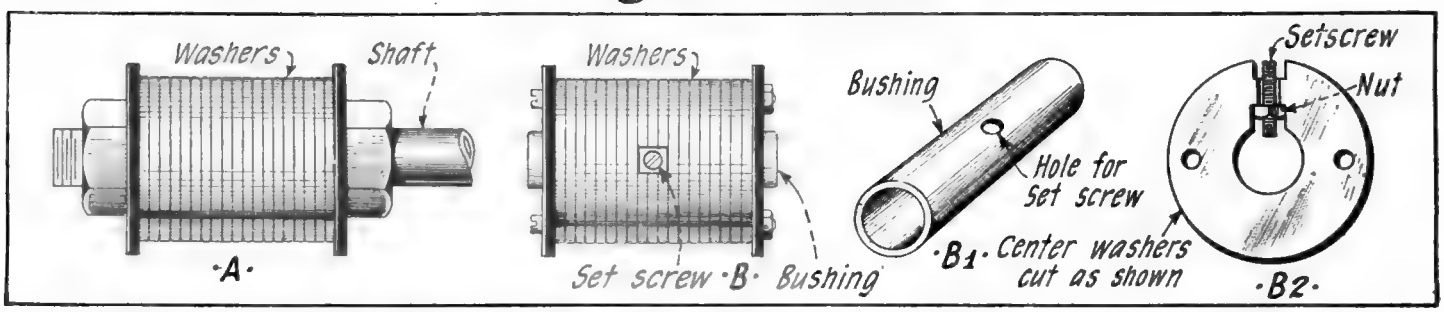
A Sensitive Hygrometer



A hygrometer that will indicate quite accurately the degree of moisture contained in the air may be constructed as shown above. A human hair constitutes the expanding element, but it must first be boiled in water for ten minutes to increase its sensitiveness to moisture. A stirrup connects the hair with the indicating lever. A paper scale completes the device. The fact that the hair is essentially horizontal gives the apparatus extreme delicacy as a minute change of length in the hair is greatly enlarged in effect.

—C. A. Oldroyd.

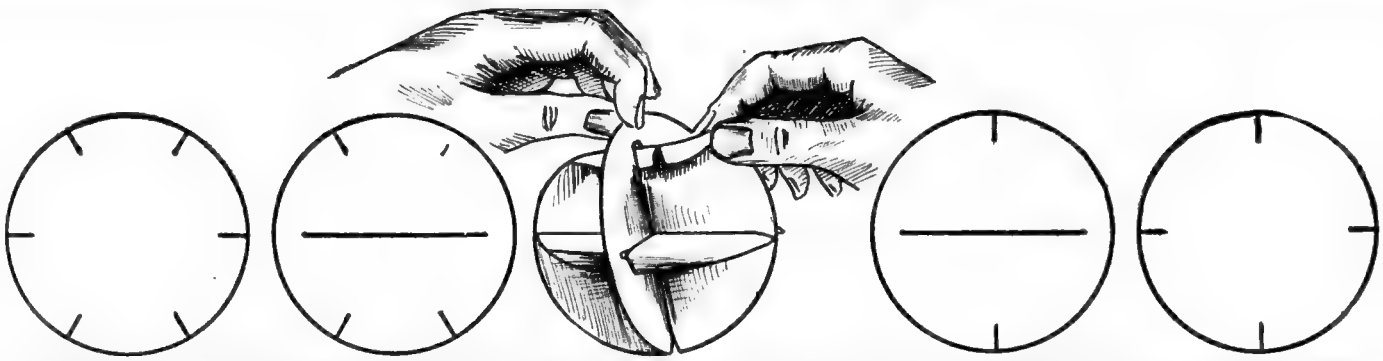
Emergency Pulleys



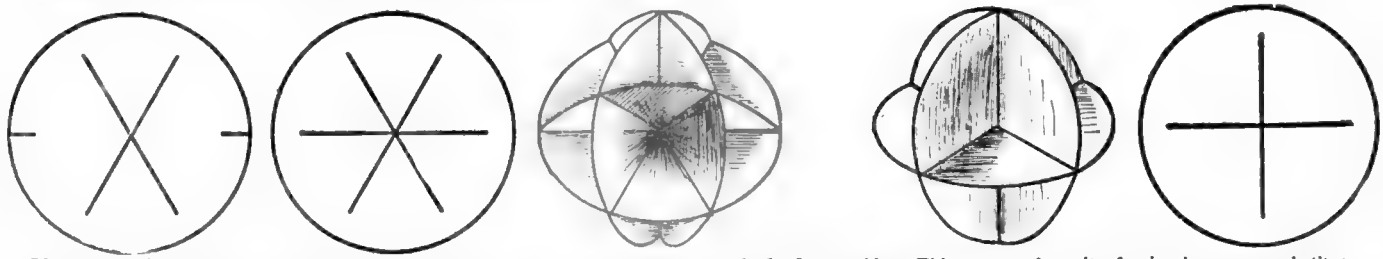
When a pulley is needed in a hurry and one of the required size is not at hand, washers may be used to build up an emergency makeshift which will give good results. Where a shaft is threaded at the end, the type illustrated at A may be used. Where the pulley has to be slipped over a shaft, the type illustrated at B must be employed. A bushing is necessary as in B1 and the center washers are cut as in B2, allowing the use of a set screw. By using fibre washers, which are procurable everywhere, a most substantial pulley of any desired width may be readily built up for belts of any kind.

—Alvin Heduall.

Interesting Paper Models



When making paper or cardboard models of crystals or solid geometrical bodies, the facets may be omitted, giving a desirable transparent effect. After models of different types of crystals or designs are made, the ingenuity of the builder will show him how such designs may be incorporated in lamp shades or ornaments, giving a very decorative effect. The model shown herewith in the course of construction is of an octahedral crystal.



The progressive drawings in this illustration show the various steps in making the model of an octahedral crystal. The heavy lines indicate the points where cuts must be made. These should preferably be made with a sharp thin bladed knife. The illustration at the top center shows the method of assembly. This system is quite fascinating as a substitute for cross-word puzzles and for one interested in crystallography will be instructive and susceptible of considerable development.—A. Gruntal.

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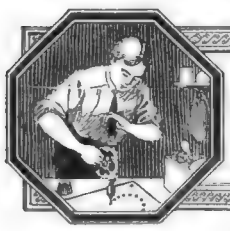
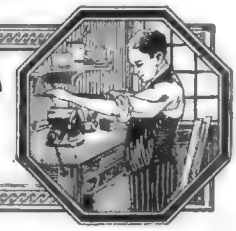
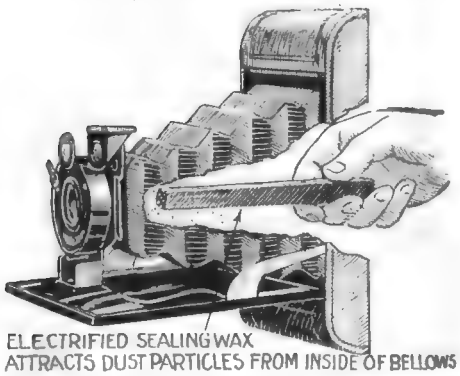


HOW-TO-MAKE-IT



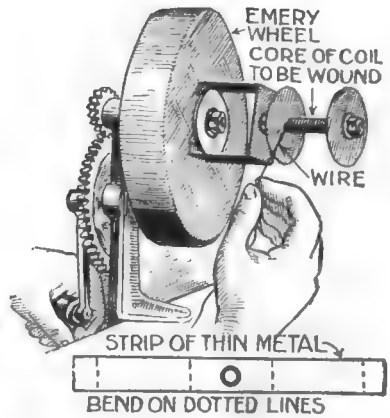
Cleaning Camera



The interior of a camera often accumulates dust and fine particles of material which are liable to collect on the lens. This is particularly true in the case of small hand-cameras where the bellows is opened and closed frequently, thereby stirring up the dust. To remove this material, electrify a stick of sealing wax by rubbing it with a piece of flannel and hold it in the bellows as shown above, moving it around.

—C. A. Oldroyd, Rep. 4433.

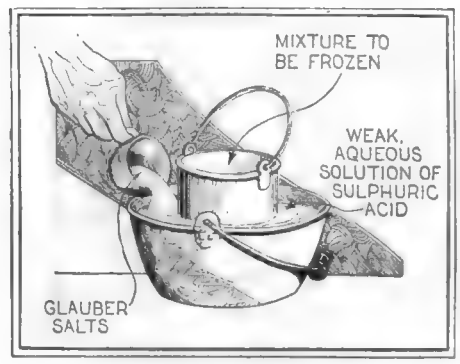
Coil Winder



The gearing of an ordinary emery wheel can be utilized to advantage in constructing a coil winder. A strip of metal for supporting the core is bent and drilled as shown above, the nut holding the emery wheel to the shaft is loosened, and the ends of the metal strip slipped under the washer. The nut is then tightened.

—Charles Craft.

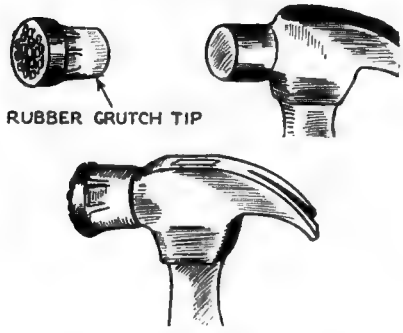
Freezing Mixture



The mixture to be frozen is placed in a pail which in turn is placed within a large bucket as shown in the above illustration. A cold weak water solution of sulphuric acid is poured into the outer container and a half cup full of Glauber's salts added. It is possible to freeze ice cream using this method.

—Philippe A. Judd, Rep. No. 7297.

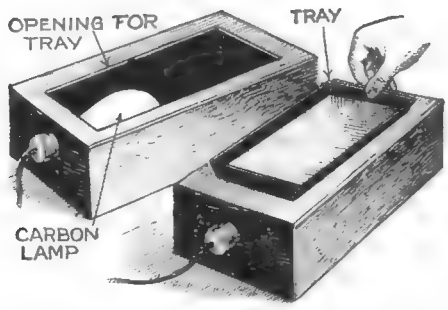
Rubber Mallet



When a rubber mallet is required for a certain job and a regulation one is not at hand, a substitute may be made as illustrated above. A rubber crutch tip is procured and placed over the end of a standard hammer as shown. The rubber must usually be stretched when placing the tip on a hammer and this tension holds the tip in position.

—Adolph Lonk.

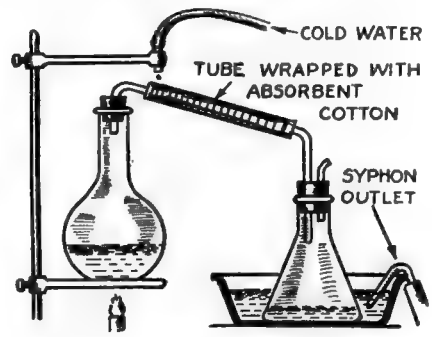
Tray Heater



In cold weather, developing trays in photographic work become so low in temperature that the developer is very slow in action. A heater made as above will remedy this. A carbon filament lamp is mounted in a cigar box, in the top of which an opening is cut as shown. The tray is placed over this opening and the heat from the lamp heats the chemicals.

—L. B. Robbins.

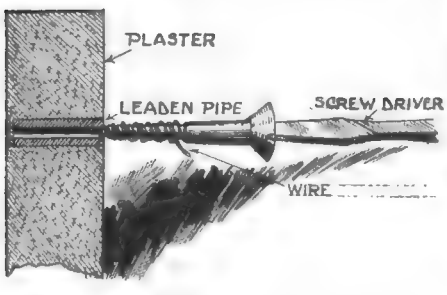
Condenser



An easily made and quickly constructed condenser for distillation purposes may be put together as shown above. A bent glass tube conducts the vapors which are cooled and condensed in their passage. The conducting tube is wrapped with absorbent cotton or cloth and cold water allowed to drip upon it. The cooling action of the water condenses the vapors.

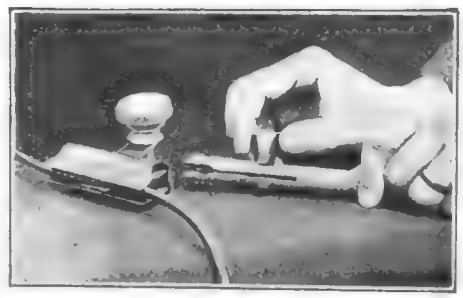
—Carlyle Weiss.

Screw in Plaster



Ordinary wood screws may be made to hold in plaster by first drilling a hole, driving a section of lead pipe therein and then turning in the screw prepared with a wire as shown above. Author please send address.

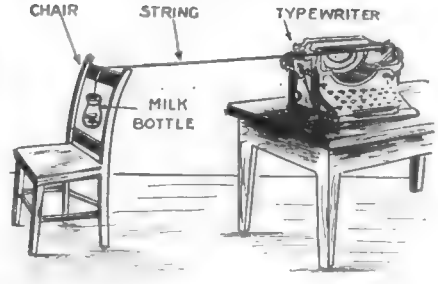
Pinchcocks



Emergency pinchcocks may be quickly and easily made from clothespins and letter clips as illustrated above. Adjusting screws equipped with wing nuts allow exact regulation of the pressure on the rubber tubing.

—C. A. Oldroyd, Rep. No. 4433.

Spring Substitute



When the carriage spring of a typewriter breaks at a time when it is most needed, a substitute may be arranged as shown. The weight of the milk bottle operates the carriage as would the spring.—A. P. D'Ambra.

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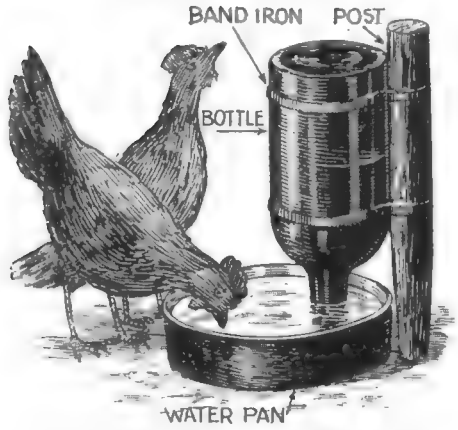
WRINKLES
RECIPES & FORMULAS

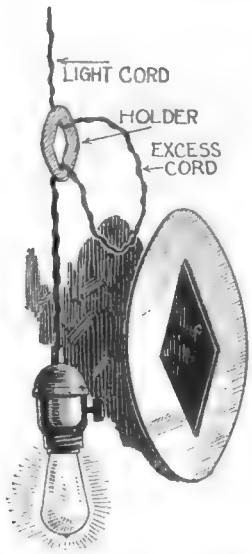
Edited By S. GERNSBACK

Water Pan



An ingenious device for supplying chickens with fresh water may be made from an old bottle and a pan. A stake is driven in the ground and two iron bands placed so as to hold the bottle in the position illustrated. Fill pan and bottle with water. Invert the bottle over the pan with the mouth immersed. Fresh water will flow into the pan when required.—Herbert E. Morris, Rep. No. 9363.

Cord Tightener

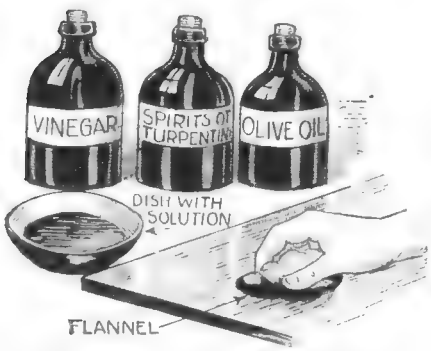


Very often electric drop lights are hung in position and it is found necessary to change the length of the cord by which the light is hung. An oval shaped holder is cut from any stiff material. A diamond shaped opening is then cut in the card as shown, making the corners quite sharp. A loop is then made in the cord and drawn through the opening of the card. The cord will catch in the corners as shown.
—Everette A. Peterson.

Card Holder

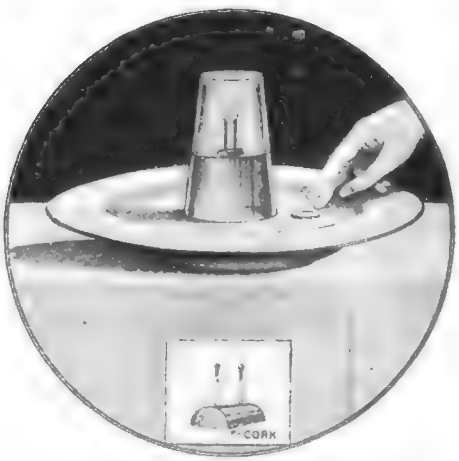
Two strips of celluloid are cut to the shape shown above. Lugs are cut in the larger one, leaving all material attached. A reporter's card is then placed in the center and covered with the smaller strip. The flaps hold it in place and keep the card clean.
— R. Krieg, Rep. No. 13307.

Furniture Polish



For polishing out scratches in furniture, mix equal parts of the above illustrated liquids. Use only a few drops and apply with flannel. For high polish, repeat several times and then finish with a dry piece of silk.
—C. A. Oldroyd, Rep. No. 4433.

Coin Trick

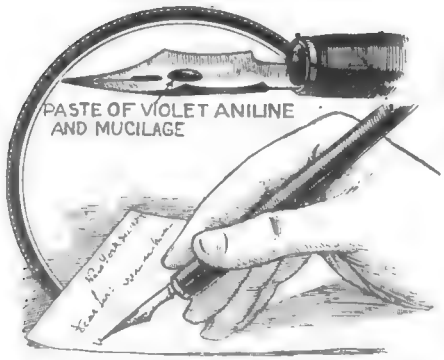


Place a coin in a dish of water and challenge anyone to remove it without wetting the fingers. This can be done by inserting two matches in a cork as shown above, floating the cork on the surface of the water and then lighting the matches. If a glass is now placed over the burning matches, and held in position for a few seconds, it will be found that all the water in the dish will be forced up into the glass. The coin will be left dry and can easily be removed.
—Dr. Albert Neuburger.

Duplicator

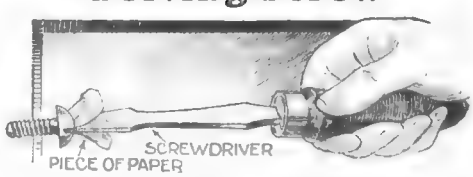
For duplicating drawings, erect a sheet of glass and place the drawing and blank paper as shown. Looking through the glass at an angle, a reflection will be seen and exact copy of the original can quickly and easily be drawn on the blank paper.—E. W. Kinner.

Inkless Pen



If a paste of violet aniline dye and mucilage is made up and a small bit of it placed on the nib of a pen as shown, writing can be done by merely dipping the pen in water. Never wipe the pen off after use, but merely allow it to dry. A pen so treated will give long service. —J. Samachson, Rep. No. 10061.

Driving Screw



If a piece of newspaper is folded as shown above, and placed between the edge of the screw-driver and the slot in the screw, the latter will be held to the driver in such a way that the screw may be started in difficult places where the fingers cannot hold it.
—M. G. Sperry.

Collapsible Tube Kink

For squeezing the material out of a collapsible tube, a sardine can opener can be put to use. The bottom edge of the tube is placed in the slot of the can opener and the latter twisted. The tube will roll up neatly and squeeze out all of the material contained therein.
—Leland B. Clark.

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Readers Forum

INFINITE DWARFS AND GIANTS

Editor, *Science and Invention:*

There is a large question-mark on the inside of my head in regard to the structure of matter. Organic and inorganic matter, according to the electron theory, the fundamental of all matter is the same, one or more negative charges of electricity held in bondage by a positive charge.

I have read all available literature on the subject for the last year or so, and the striking similarity of the atom to our solar system has produced the question-mark mentioned, and it opens up such an enormous field of speculation or imagination, that I am mired! Inasmuch as I have never seen a theoretical treatise on the matter in question, I am desirous of starting same.

The subject is too deep for the layman to do more than wonder, but I can't help but do that. The atom containing its nucleus and electrons as a miniature universe, is immensely thrilling, and it looks to me that such being the case, the electron is not the smallest particle of matter as is supposed, but is probably habitat of thousands of forms of life which may be the generators or germs of all life. And our universe with its sun and planets is possibly only an atom of matter, matter formed by it and the hundreds of other universes indicated by the Milky Way. If such is the case, it relegates poor little man to a very unimportant position in the scheme of things unless by evolutionary methods we continue to the higher plane of matter as we have from the tiny electrons. But if there is another stage or higher continuation of matter solidified by the universes, perchance another form of life much larger than we—as we are the electron—and with a life span in proportion, as our span of life is to that of the amoeba, for example, exists.

The argument against that is of course that such a high organism would manipulate matter as we do, but what if they do? Would we know the difference any more than a germ of life in the electron would know when steel was melted or powder exploded, or mercury transmuted into gold? I expect we would know should our earth go hurtling through space to another universe. But probably that explains comets and various other solar phenomena.

L. W. Hunt,
Harrisburg, Ill.

(This same theory was the basis of a story which we recently featured, entitled, "Around the Universe," in which the earth was an "atom" and all the stars and planets other "atoms," making an ultimate structure infinitely great. Several stories by Clement Fezandié featured the other view of the subject just mentioned, namely, the possibility of life on the minute atoms. The suggestion is not in itself new.—Editor.)

A Chemical Club

Editor, Science and Invention:

Referring to the articles by Mr. John C. Henderson, member of the American Chemical Society, in the August, 1920, issue of Science and Invention. All the articles were worthy of serious thought on the part of amateur chemical enthusiasts, and I advise any of them who may read this to refer to their old copies of Science and Invention and read them. I notice that the suggestion was endorsed by the editors in a note immediately after the article. I did not realize the importance of the articles at that time, having become interested in chemistry some time later, but having read it over recently I would like to express my ideas on the subject. As chemistry is such a great and growing industry, there must be many interested experimenters in this line. If they were banded together, would it not be a great help and inspiration to those who have not had such help as they would receive from their fellow experimenters in an organization of this sort? The work of the society, encouraging the study of chemistry, as Mr. Henderson suggests, would be a great help to the industry in future years. Such a society, as Mr. Henderson says, would surely promote the interests of the amateur chemists and eventually that of the whole industry. I should think that almost every amateur experimenter, chemical or otherwise, would take Science and Invention, and, therefore, any help from this magazine, as Mr. Henderson proposes, would reach many interested experimenters. I should like to see the article published again in an effort to awaken interest among the amateur chemists.

John E. Cummings, Jr., Wyoming, R. I.

(There are many chemical experiments being published in the Experimenter Magazine, *which you will find advertised elsewhere in this publication. This is an ideal publication for amateur experimenters. For those desiring articles of a non-technical nature we suggest such publication. For the sake of those who are not fortunate enough to have an August, 1920, issue of* Science and Invention Magazine *on hand, we are republishing the letter of Mr. John C. Henderson.*

"The war-time closing of the wireless stations, the most popular and best developed field for the experimenter, made it necessary for thousands of scientifically inclined young Americans to find some other field of activity upon which to expend their surplus time and energy. The writer wishes to suggest a line of work in a field which would not be thus affected in case of war, and one which offers a splendid opportunity for patriotic service, namely, the field of chemistry.

"Due to German supremacy in the chemical industry, this country was, before the war, dependent upon Germany for a large proportion of the chemical products needed in its industries, and when the German markets were closed to us, many of these industries were seriously affected. We must secure chemical independence from Germany as well as make the world "safe for democracy." The war of arms, in which we strove to destroy Germany's military supremacy, has brought about a war of brains in which we must combat her chemical supremacy. Every experimenter in the country should get a working knowledge of the principles of general chemistry, and, if possible, of analytical and industrial chemistry, as well, in order that he may be prepared to play his part in the struggle to free the United States from its dependence upon any foreign country for chemical products.

"The writer, therefore, suggests that a national society be formed to promote the study of chemistry, and that Science and Invention *sponsor the movement and act as the official publication of the society.* Science and Invention *is the best fitted magazine in this country for such a task. Its work in organizing the amateur wireless operators of the country, and in building up the greatest amateur wireless association in the world, is well known, and it has a splendid reputation for supplying the latest and most authoritative wireless and electrical news to its readers. It is already publishing a large number of chemical articles, and it would be but a step from this work to the organization of a national society for young chemists, a sort of Junior American Chemical Society.*

"The object of the society would be to encourage the study of chemistry, to bring all the chemical experimenters into one great organization, to enable local societies to be formed of experimenters who live in the same locality, and to build up a market for chemical supplies for amateurs, so that the supply houses will be justified in carrying large stocks of supplies, and in selling them cheaply. This last point is very important. When the wireless game was new, and there were but a few wireless experimenters, the demand for amateur wireless materials and instruments was so small that supply houses carried very incomplete lines, and were forced to charge almost prohibitive prices to make any profit at all. As more and more experimenters became interested in wireless, and as they became better organized, the demand for instruments and materials became so great that the supply houses were able to carry a much more varied line and sell it cheaper. This movement went on until a great variety of equipment was available at very reasonable prices, and the study of wireless was within the reach of almost everyone.

"The same thing will be true of the study of chemistry. If a large number of experimenters take up the study, organize and make known their wants, the supply houses will begin to carry large lines of chemical equipment and reagents at low prices, and this action in turn will encourage more experimenters to take up the work, until a great organization will be built up which will be of immense service to the country in developing chemists to meet the ever growing need."

*And such a movement is still in order.—*Editor.)

John C. Henderson,
(Member American Chemical Society),
Akron, Ohio.

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it in. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

The Experimenter

has come back! If you are one of the one hundred thousand readers of the old Electrical Experimenter, you will no doubt be glad to hear that the Experimenter is coming back BIGGER AND BETTER THAN EVER. Practical Electrics has been changed into an entirely new kind of magazine entitled

The Experimenter

In this magazine which has been greatly enlarged in point of contents, illustrations and circulation, you will find the following new departments:

Experimental Radio
Experimental Chemistry

There is an entirely new treatment of radio containing experiments only. *90% of the magazine contains pure experiments* written by the foremost authorities in their respective fields, also a monthly editorial by the writer.

A fine roto-gravure section is now added to brighten up the magazine. *If you want experiments, this is your magazine.*

Be sure to reserve a copy from your news-dealer before the issue is sold out. THE EXPERIMENTER will be on sale at all newsstands beginning March 20th, 1925.

Hugo Gernsback
Editor

SPIRITS AGAIN

Editor, Science and Invention:

I read the letter about spiritualism in the January issue of Science and Invention Magazine, and would like to comment on the same.

I positively know that there are such things as spirit or psychic phenomena. Until recently we have had at our house a medium who is a very dear friend of ours, and who has repeatedly given séances. Things happened that absolutely could not be duplicated by any mortal. We only permitted members of our family to be present. The medium would sew his hands through the finger tips to the person sitting next to him and have his shoes nailed to the floor.

Some of the manifestations were beautiful lights, trumpet talk, raps and occasionally we would all be presented with a flower. The medium would always be in a dead trance. Sometimes he would be thrown to the floor with force enough to cause injury to a person under normal circumstances.

Having heard of spirit photography, I decided more as a joke than anything else to take some "spirit" pictures. I took down a picture from the wall of a sister who had passed away. With a box camera I took a time exposure of the photograph and developed it. Upon first examination I could see nothing unusual. When I took the picture home my folks recognized four faces on the photograph. These faces have grown plainer on the photograph every day, and are more clear now than when they were first taken. I am inclosing the picture for your examination.

On another occasion after a séance I took a fresh plate and laid it under the bed. The next morning I developed it. This photo shows a light spot.

Can you offer an explanation of these things? I am a boy of sixteen and until recently did not believe in spiritualism.

Will J. Rehklau, Monroe, Mich.

*(If you will take a picture of a girl whose hair is fluffed, you will find that in the picture a number of faces can be made out in the hair. You have often observed the clouds as they go rolling by, molding themselves into various fantastic shapes, forms and figures. Sometimes the clouds will appear to be human beings; at other times gigantic animals. These effects are entirely natural and do not take on human being-like shapes because of any occult powers. The cloud shapes and their association in our minds with objects familiar to us are due entirely to machinations of the mind, and we believe that they appear human-like because our mind naturally theorizes. The same is true of the first spirit picture you took. Careful scrutiny does not revealed the presence of faces. By deliberately looking for an effect in the photo, one could even see a hobgoblin. The second photo showing the light area is merely produced in the development of the film. If you will take a crystal of hypo-sulphide of soda and drop it upon a plate while the same is in the process of development, various fantastic and grotesque shapes will be produced, some even resembling human beings, but we can assure you there is no psychic force at stake. We will make the following assertion, although we know that it will not please you. The medium who is sitting for you is a deliberate out-and-out fraud, and we are willing to prove it by offering him his railway fare to New York City, and in addition offer him any of the various prizes which we have listed which come under the group of manifestations which he produces. We will also pay his expenses while here in New York City making these tests for us, will laud him from the housetops if we cannot prove that he employs trickery, but will likewise publish the exposé describing how he does his tricks, if we catch him in trickery.—*Editor.)

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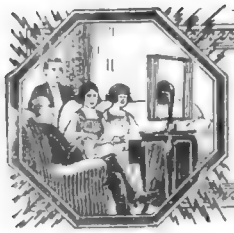
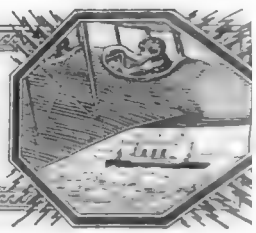
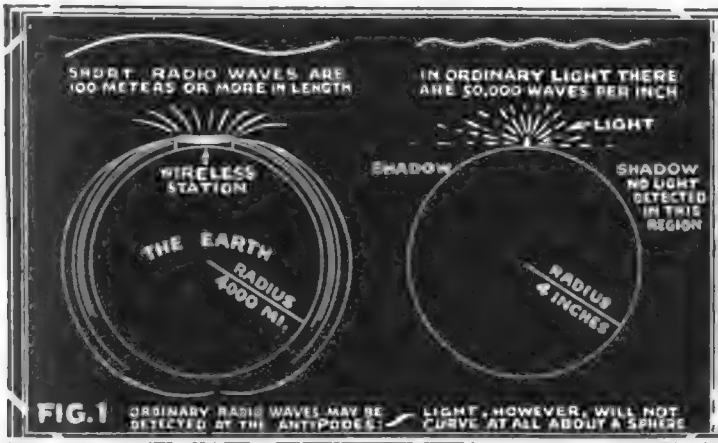


RADIO

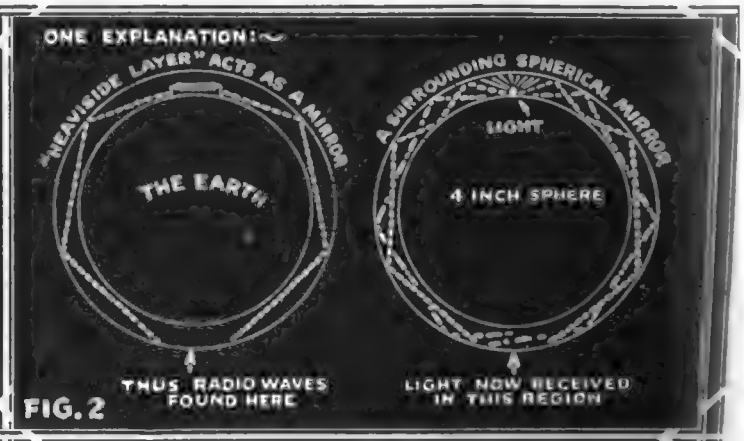


The Larmor vs. Heaviside Theory

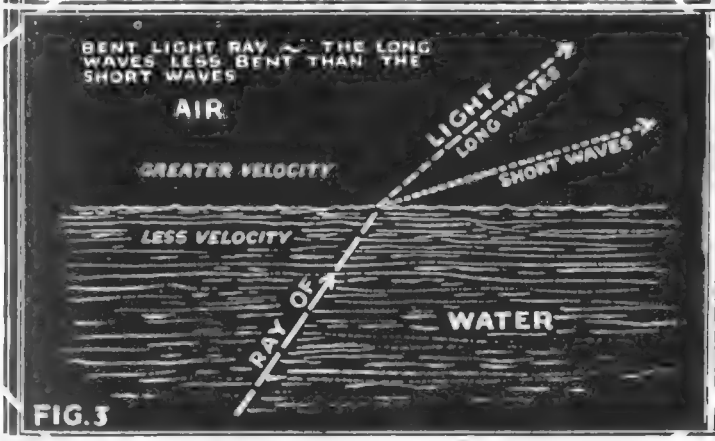
By DR. JOSEPH M. HOWARD


SHORT RADIO WAVES ARE 100 METERS OR MORE IN LENGTH
IN ORDINARY LIGHT THERE ARE 50,000 WAVES PER INCH
LIGHT
WIRELESS STATION
SHADOW
SHADOW NO LIGHT DETECTED IN THIS REGION
THE EARTH
RADIUS 4000 MI.
RADIUS 4 INCHES
FIG. 1 ORDINARY RADIO WAVES MAY BE DETECTED AT THE ANTIPODES; LIGHT, HOWEVER, WILL NOT CURVE AT ALL ABOUT A SPHERE

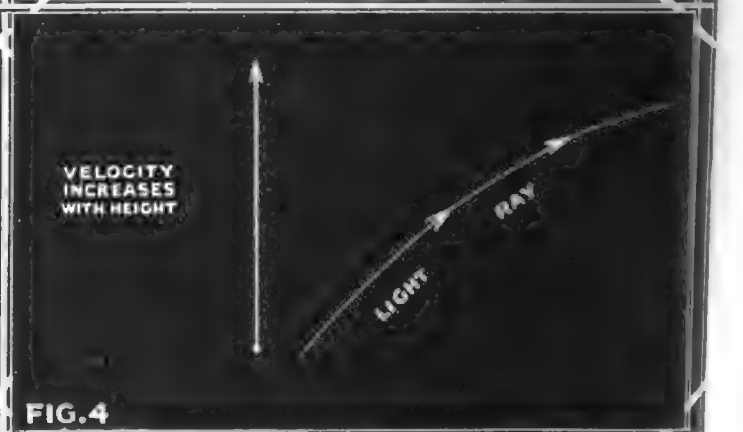
It is a well established fact proved by science that the only difference between light and radio waves is in their lengths. Light travels in straight lines while radio waves which ought to follow the same laws, are bent entirely around and can be received at the antipodes.



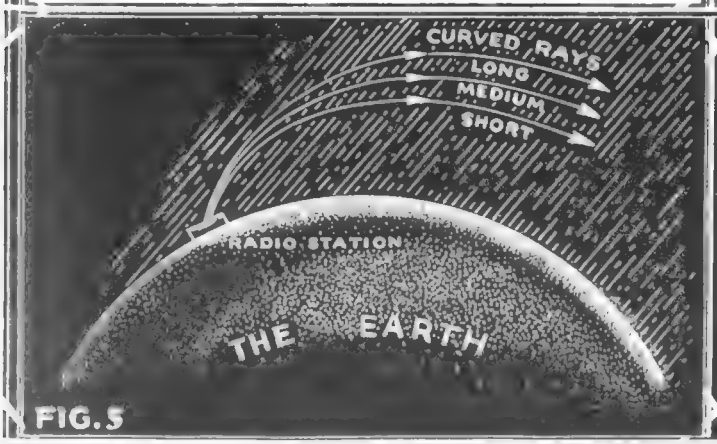
Heaviside claimed that the reason for the bending of the waves is due to an ionized layer about 100 miles above the surface of the earth which acts as a reflector. Similarly, in harmonious analogy, a spherical mirror will reflect light completely. Note the diagrams.



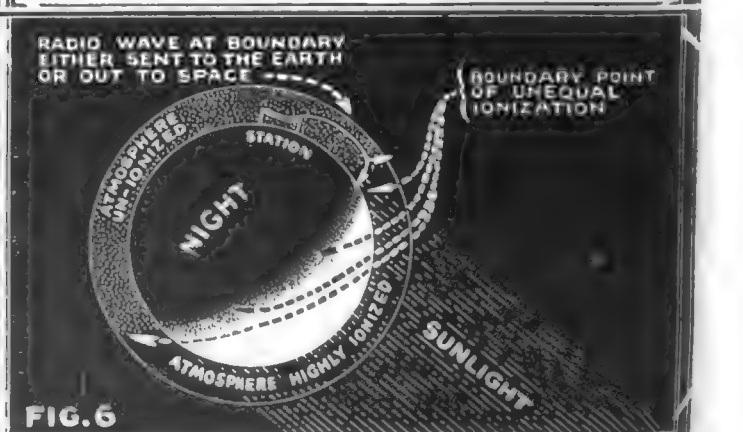
Light is also bent by refraction, a well-known phenomenon which takes place when it passes from a lighter to a denser medium and vice-versa. Sir Joseph Larmor contends that the Heaviside layer, if it exists, would act to absorb the radio waves and to damp them out quickly.



Einstein, whose remarkable work on the theory of relativity is one of the great achievements of modern times, shows that if we replaced the air by some hypothetical medium, so that the velocity of light would increase, its path would be curved, eventually back to its origin.



Larmor shows that a layer of electrons exists about 50 miles above the earth and produces the same effect as such hypothetical medium. As with light, the shorter radio waves are bent more than the long and thus lie nearer the earth's surface.



Therefore, due to the lesser absorption it is seen why short waves carry further. It also accounts for the well-known fact that North and South transmission is better than East and West. The boundary line of unequal ionization acts as a barrier.

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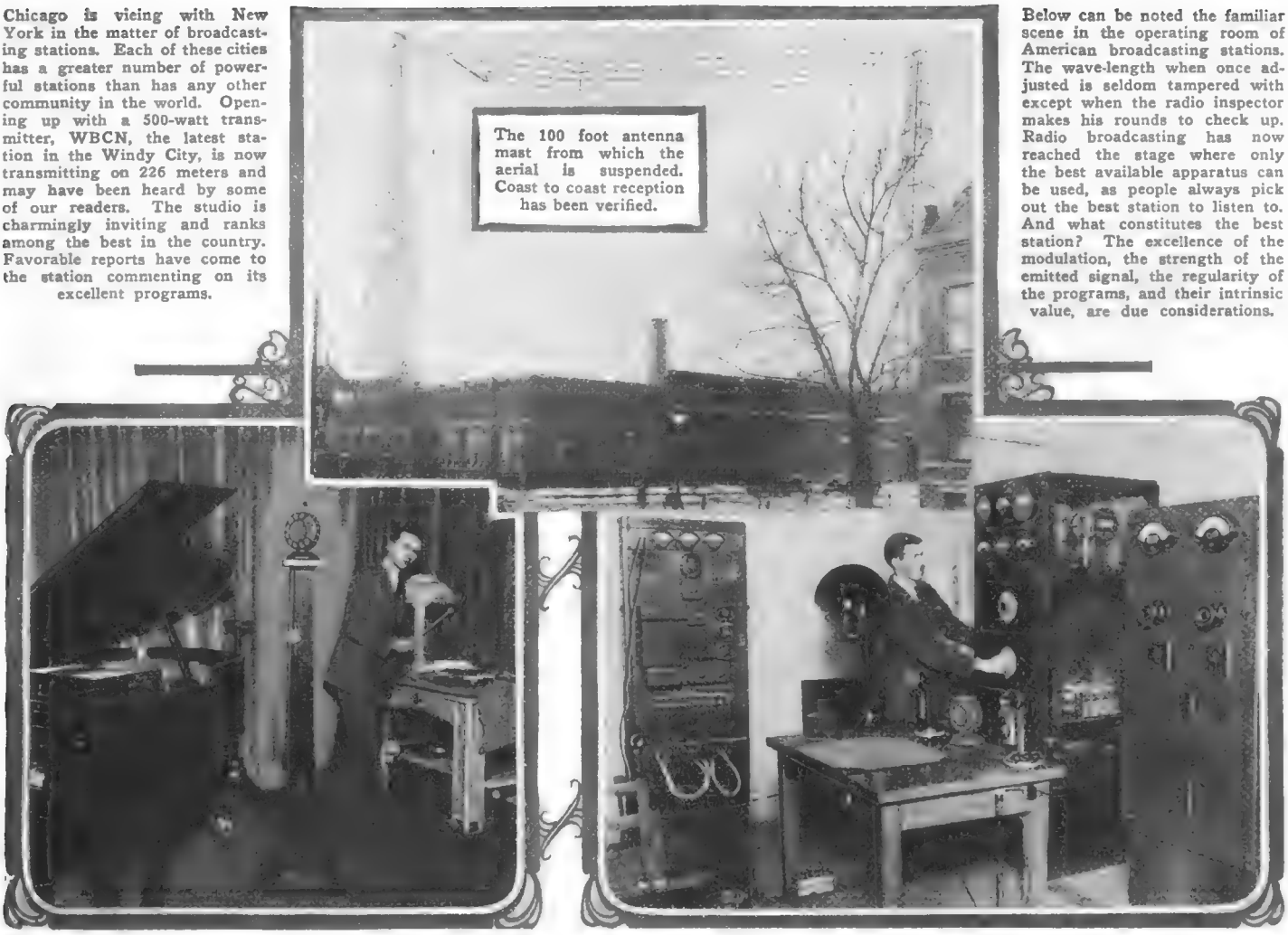
WBCN, New Chicago Station

Chicago is vieing with New York in the matter of broadcasting stations. Each of these cities has a greater number of powerful stations than has any other community in the world. Opening up with a 500-watt transmitter, WBCN, the latest station in the Windy City, is now transmitting on 226 meters and may have been heard by some of our readers. The studio is charmingly inviting and ranks among the best in the country. Favorable reports have come to the station commenting on its excellent programs.

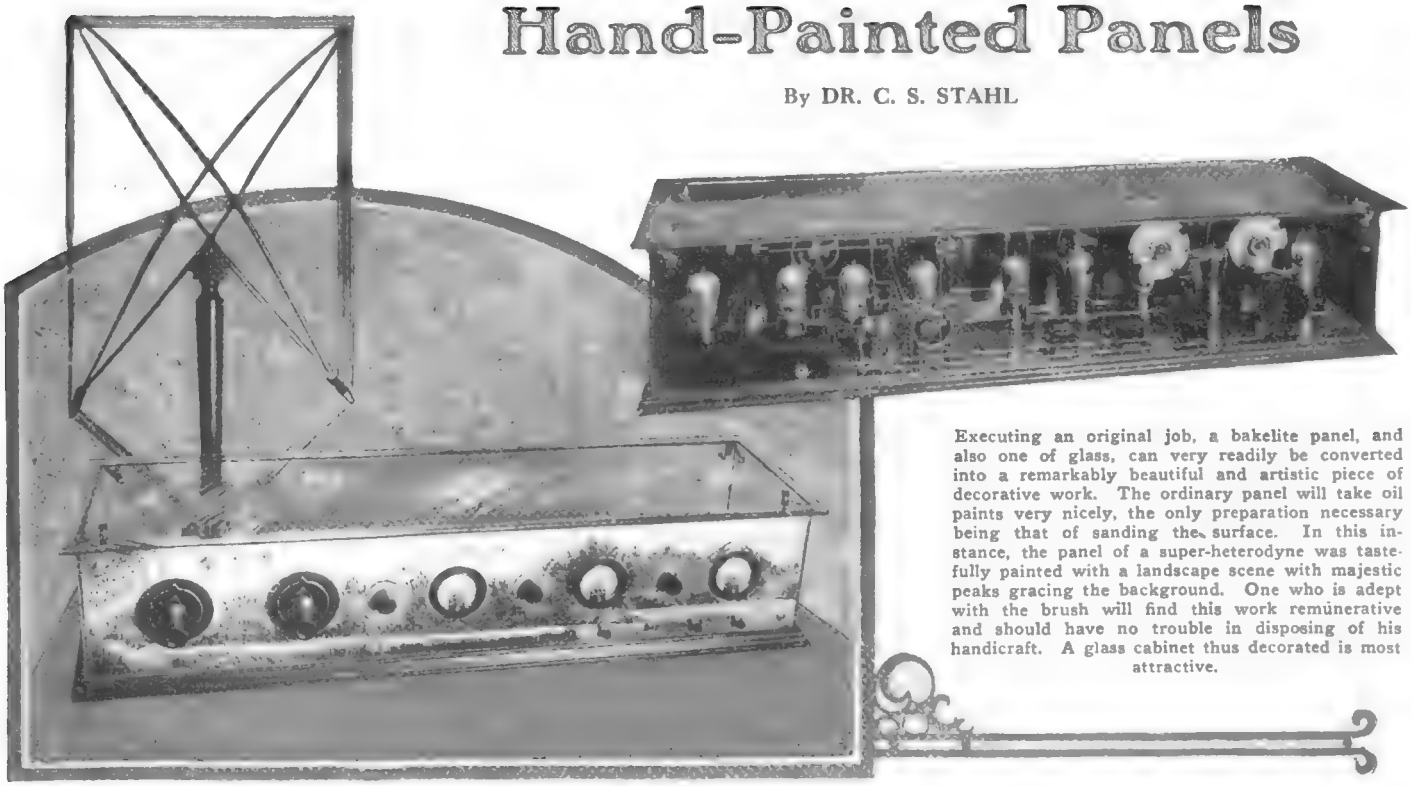


The 100 foot antenna mast from which the aerial is suspended. Coast to coast reception has been verified.

Below can be noted the familiar scene in the operating room of American broadcasting stations. The wave-length when once adjusted is seldom tampered with except when the radio inspector makes his rounds to check up. Radio broadcasting has now reached the stage where only the best available apparatus can be used, as people always pick out the best station to listen to. And what constitutes the best station? The excellence of the modulation, the strength of the emitted signal, the regularity of the programs, and their intrinsic value, are due considerations.

Hand-Painted Panels

By DR. C. S. STAHL



Executing an original job, a bakelite panel, and also one of glass, can very readily be converted into a remarkably beautiful and artistic piece of decorative work. The ordinary panel will take oil paints very nicely, the only preparation necessary being that of sanding the surface. In this instance, the panel of a super-heterodyne was tastefully painted with a landscape scene with majestic peaks gracing the background. One who is adept with the brush will find this work remunerative and should have no trouble in disposing of his handicraft. A glass cabinet thus decorated is most attractive.

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European Broadcast Map

In England, there exists a tax on receiving apparatus. France and Germany both have very stringent rules regarding the reception of radio broadcasting. In the latter country, it is necessary to file an application with the Police Department in order to procure a license for receiving! Some countries forbid entirely the use of radio apparatus. America leads in radio broadcasting.

"I HEARD Europe last night. Yes, music and words came in loud clearly, but I do not know exactly what wave-length was." Similar remarks to can be heard almost daily, and it gives pleasure to be able to give our readers latest and most complete data concerning location and wave-length of all the kn European Broadcasting Stations. Engl alone has nineteen powerful stations tr mitting on wave-lengths ranging from to 1600 meters. It is possible that the future will witness a chain of ultra pov ful stations circling the globe and brin the remote corners of the earth togethe

This does not necessarily imply that su broadcasting stations will replace our sm ones, but means that another epoch wil established which will aid in extending able worldly relations.

Station Log

A very handy device which constitutes a complete station recorder and chart having the stations listed alphabetically on a set of rollers, has recently been placed on the market. The chart is so arranged that the dial readings can be marked down for the corresponding station. Two small knobs protruding from the side, facilitate quick adjustment.

Phonograph Unit

Those who wish to use their phonograph in c junction with the radio set, will find this n unit to be a very excellent reproducer. Sim by placing the reproducing needle on the vice, excellent results in the way of tonal qu ity can be obtained. Name of manufact will be given on request.

Neutralizer

A novel type of neutralizing condenser has be evolved with the view in mind of a compact a low-loss device to meet the requirements of rapidly advancing field of radio science. features can be clearly understood by the abo photo which shows it to be entirely differ from the average. Mica insulation is us

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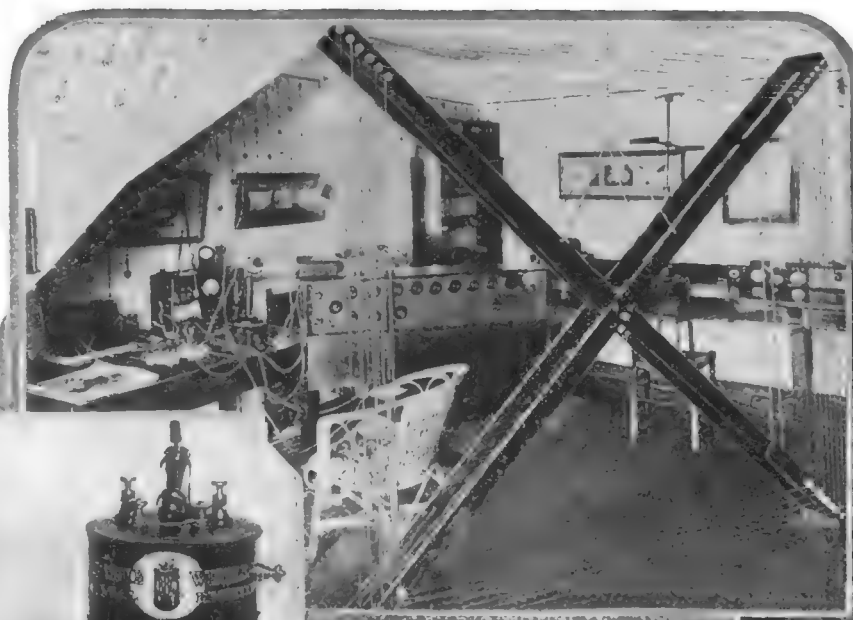
Radio Odds and Ends

Below: A matter of relative values. This curious photo shows a small crystal set, a salt cellar and a very expensive lump of the sensitive mineral Hertzite. The crystal set is valued at about $2.00 while the mineral is worth at least 500 times that amount. As for the salt cellar—oh, well, Woolworth's best is entirely reasonable! Just why this combination was chosen for the photo we do not know, but surmise that the photographer is thoroughly acquainted with Einstein's Relativity Theory.

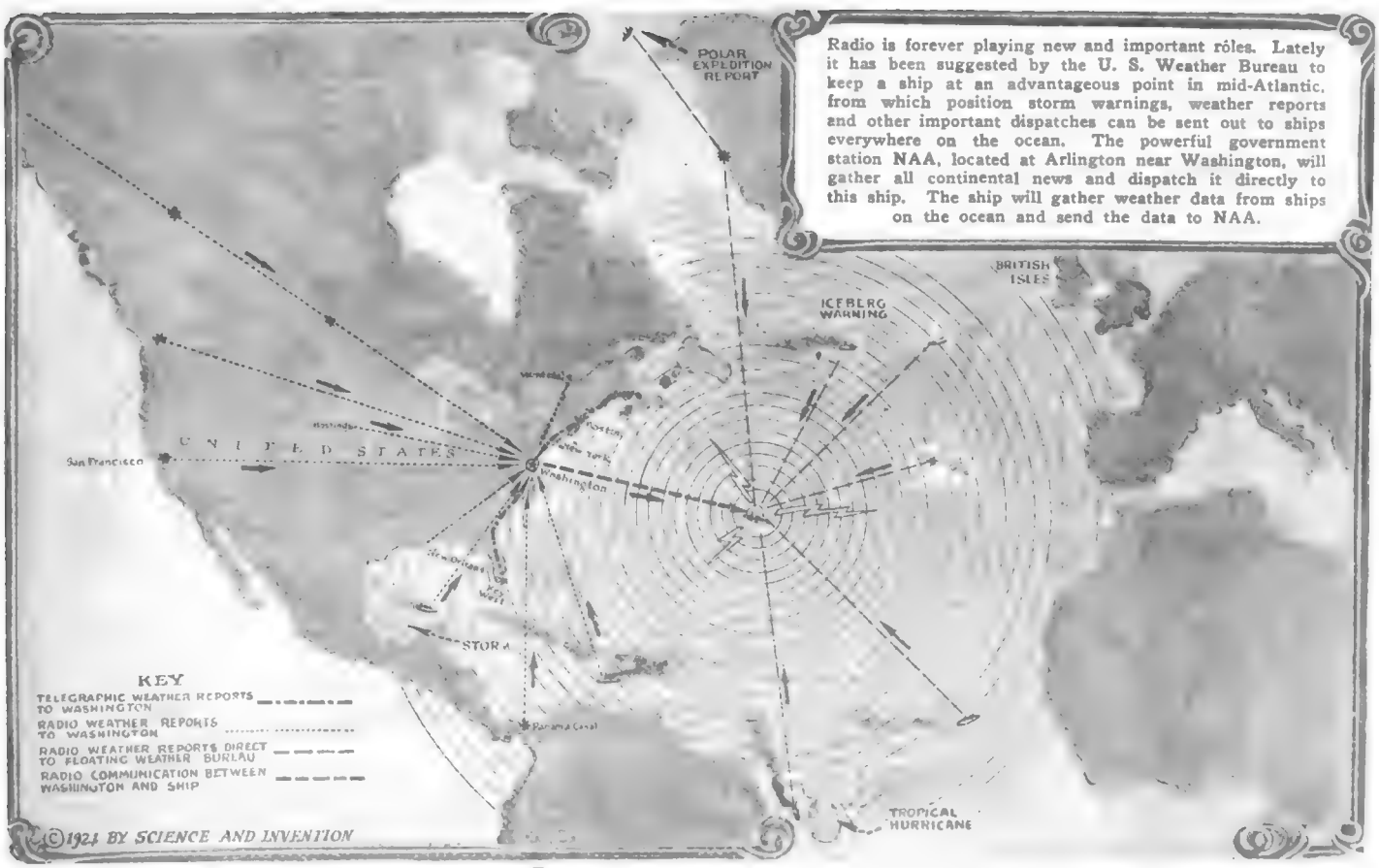
What they use on the other side to receive our short-wave stations. A large loop antenna in conjunction with a 'steen tube super-heterodyne is used to receive with regularity the 94 meter wave of KDKA and those of 104 meters from WGY.



How to convert a thermometer into an ammeter for the purpose of measuring filament current. Four or five turns of wire are wound around the base and connected in series with the "A" battery. To calibrate the instrument, mark off on the scale the reading when one, two, three and more tubes are burning. Refer all readings to a given temperature mark.

Mid-Ocean Radio Weather Bureau

Radio is forever playing new and important rôles. Lately it has been suggested by the U. S. Weather Bureau to keep a ship at an advantageous point in mid-Atlantic, from which position storm warnings, weather reports and other important dispatches can be sent out to ships everywhere on the ocean. The powerful government station NAA, located at Arlington near Washington, will gather all continental news and dispatch it directly to this ship. The ship will gather weather data from ships on the ocean and send the data to NAA.



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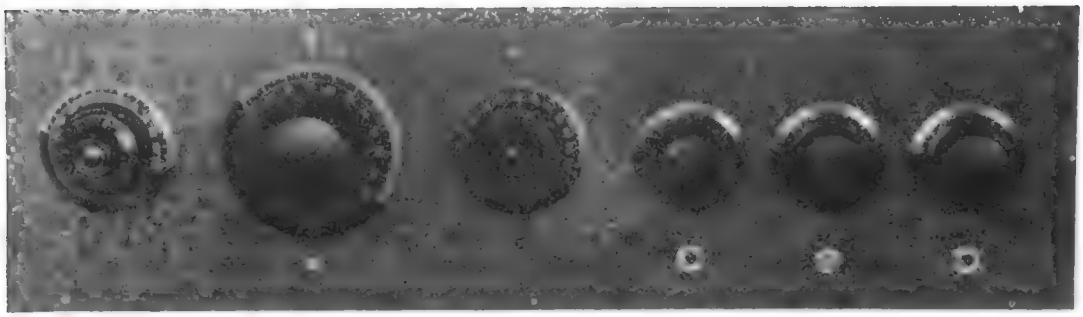
A Four Tube Distance Getter

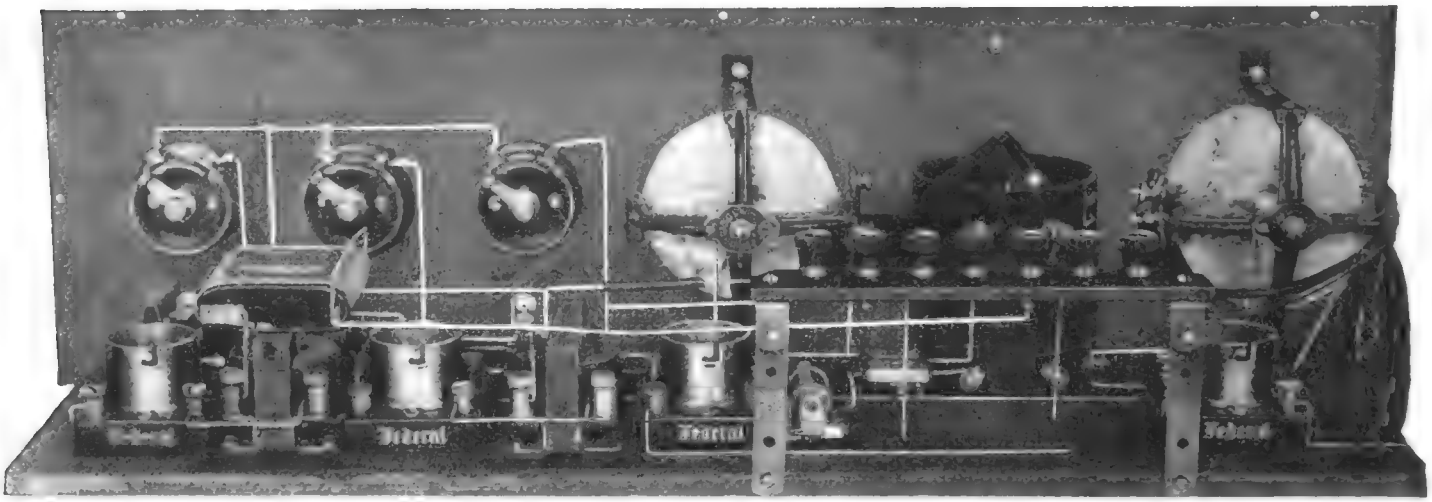
By SIDNEY E. FINKELSTEIN, A. M., I. R. E.

One Stage of Tuned R. F., Regenerative Detector and Two Stage A. F. Amplifier

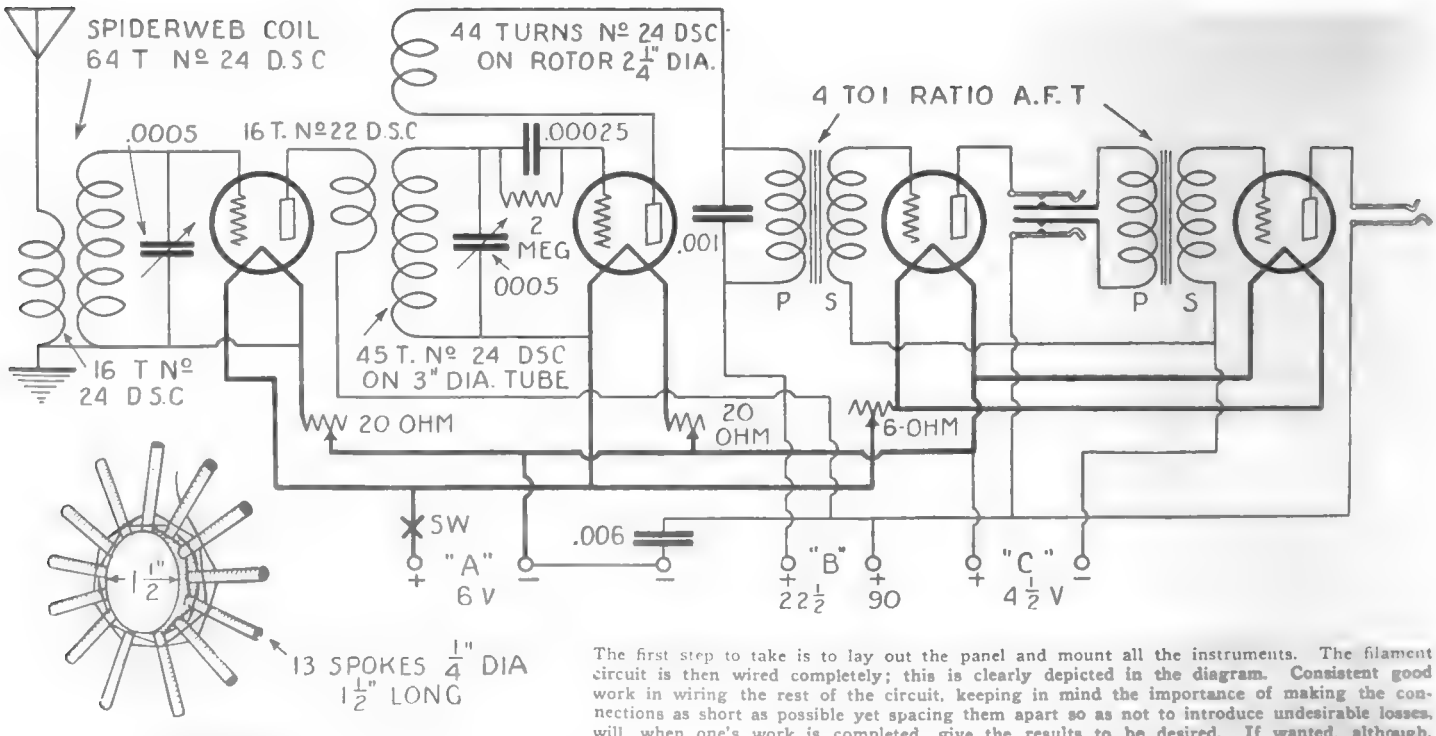


Note the pleasing appearance of the grained panel and the symmetrical lay-out of the apparatus. While six controls are shown, only two are required for tuning, with an optional dial for regeneration.

The one who has completed his first single tube regenerative receiver and who wishes to add to its distance-getting ability and volume, will do well to follow the suggestions incorporated in this article. A 7 x 24 panel accommodates all the instruments without crowding and allows ample room for doing a neat wiring job which is necessary for good results. Vernier dials are used with the two tuning condensers.



Simplicity is the keynote of this set. The list of parts becomes apparent upon casual observation. Two .0005 variable condensers, four standard sockets, three rheostats, one vario-coupler and spider-web coil, three fixed condensers, one grid leak, two audio frequency transformers, two jacks, one filament switch and the necessary binding posts, complete this receiver. As will be seen in the photo, most of the connections go to binding posts, thus, requiring a very minimum of soldered connections, as soldering goes to make the assembling of a radio set a disagreeable job. Material of recognized quality is used in its construction. This has much to do with the production of really satisfactory sets.



The first step to take is to lay out the panel and mount all the instruments. The filament circuit is then wired completely; this is clearly depicted in the diagram. Consistent good work in wiring the rest of the circuit, keeping in mind the importance of making the connections as short as possible yet spacing them apart so as not to introduce undesirable losses, will, when one's work is completed, give the results to be desired. If wanted, although, it is not necessary, a double circuit jack can be placed in the detector circuit.

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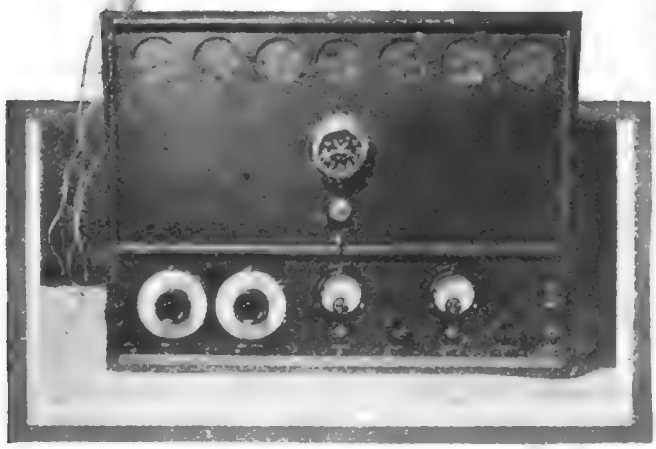
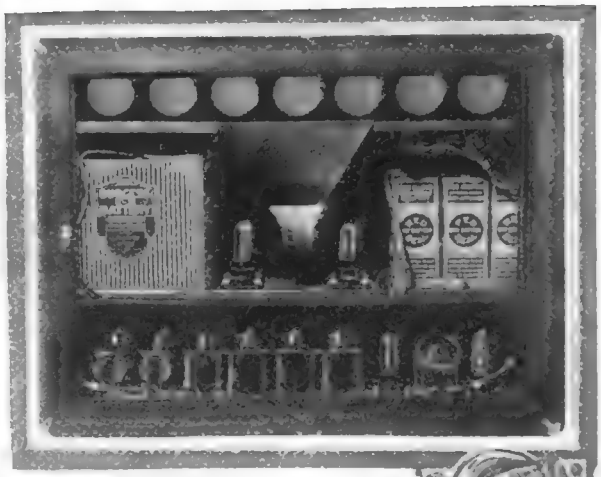
The Ritz Super-Het

By CHARLES CAESAR RITZ

UV-199 Portable Receiver Without a Peer

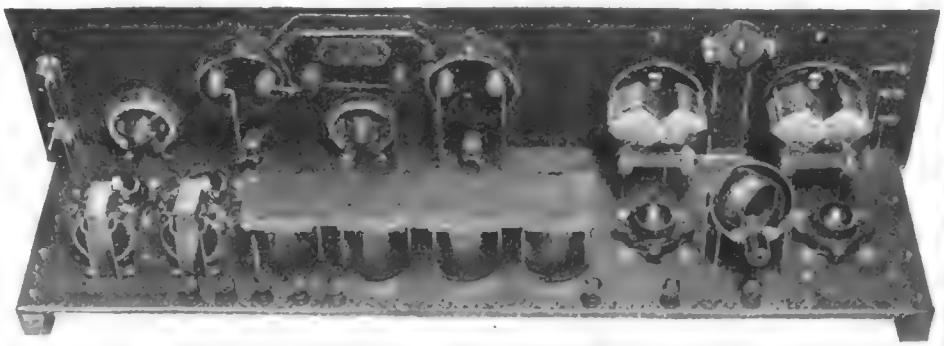


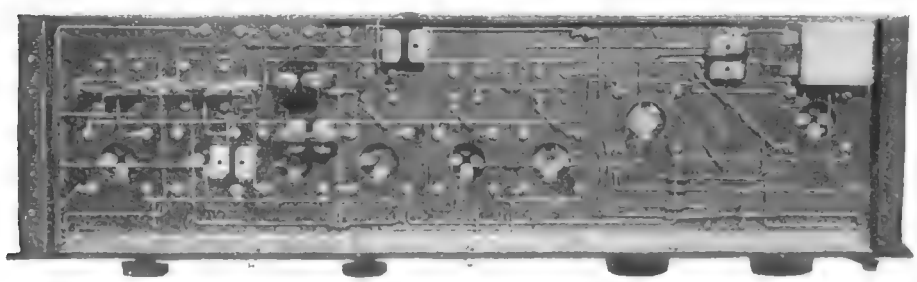
Our readers will remember the exceptionaly good article on the "Ritz Super-Neutrodyne" published in our columns a few months ago. During this time Mr. Ritz has been laboriously at work and has perfected a receiver which a series of tests have proved it to be, without a doubt, the best set of home-made construction we have ever as yet seen.—Ed.



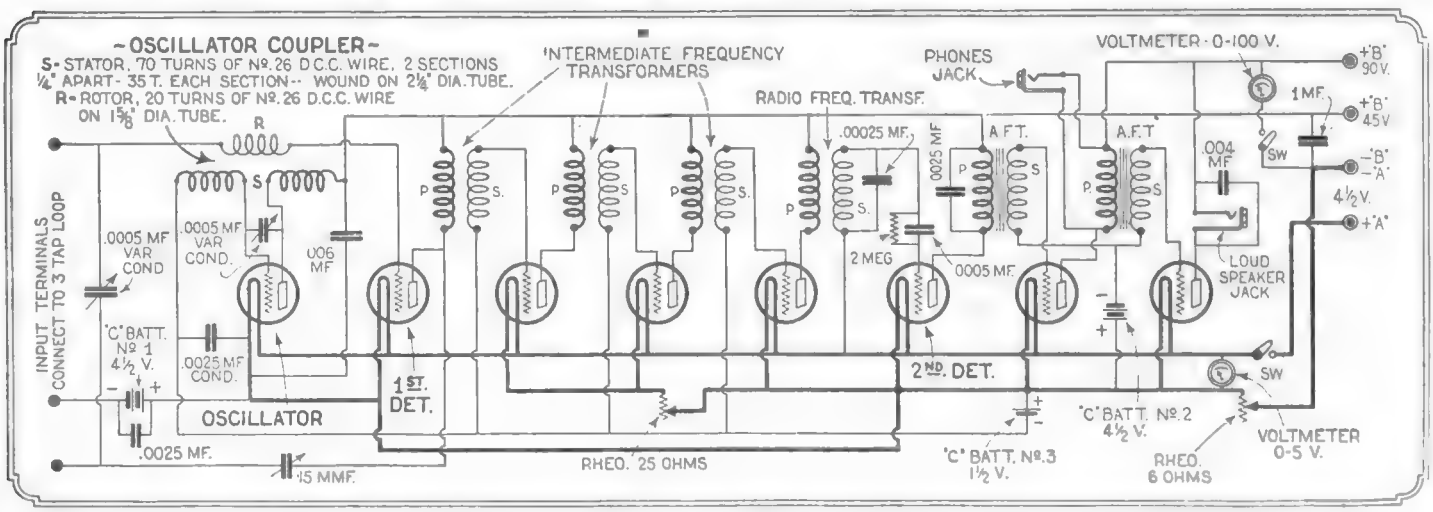
The cabinet containing the set is 38 inches long by 28 inches high and is 8 inches deep. Of course, it is not portable in the sense of the word to the extent that it can be carried around by hand, but is for automobile use in travel.

This receiver, the result of patient research, has as its outstanding features: maximum sensitivity, maximum selectivity, minimum size without reduced efficiency, minimum number of controls, maximum stability during operation and most important of all employs a circuit which is easy to wire and when once built does not necessitate considerable adjustment, matching of tubes, nor gives undesirable and exasperating trouble. Deviation from given dimensions is allowable, although it is imperative that the specified parts be used. The receiver is perfectly balanced in all circuits and even a slight change in the value of such a small thing as a fixed condenser will be quite noticeable in the results attained. A panel 36 by 8 accommodates the receiver proper. Note clean-cut workmanship and self-contained batteries and the loud speaker.





Especial note should be taken of the wiring which is brought out on the base sub-panel and very carefully soldered. The intermediate frequency transformers are racked together upside down, so that the leads to them become short. Four spare tubes are carried in the space near the loud speaker horn and are available in case of emergency. Six dry cells are connected in series-parallel, giving the proper filament voltage to operate the eight UV-199s.



For best results, it was found that a loop having a center tap and composed of 15 turns 2½ feet square works remarkably well, Pacific Coast stations being heard every night during the week regardless of the weather conditions. 45,000 cycle transformers give best results in the intermediate frequency stages and as will be seen in the diagram, their output is tuned. This is very important and far superior to tuning the input. (This article has been obtained exclusively by SCIENCE AND INVENTION and is recommended to the attention and appreciation of our readers.—Ed.)

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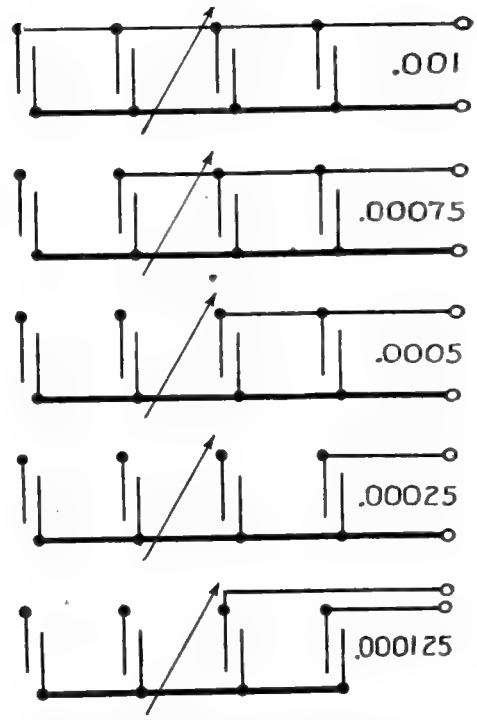
A Multi-Range Wavemeter

By SIDNEY E. FINKELSTEIN, A. M., I. R. E.

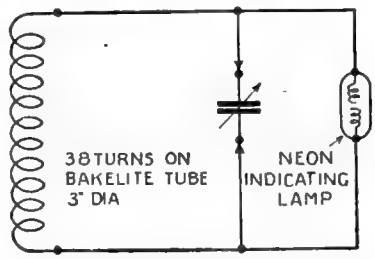
An excellent addition not usually found in the average experimenter's laboratory is an accurately calibrated wavemeter. This article is perhaps the first of its kind dealing with a combination employing a single inductance and a multi-section condenser for a wavemeter covering a range between 75 and and 600 meters.



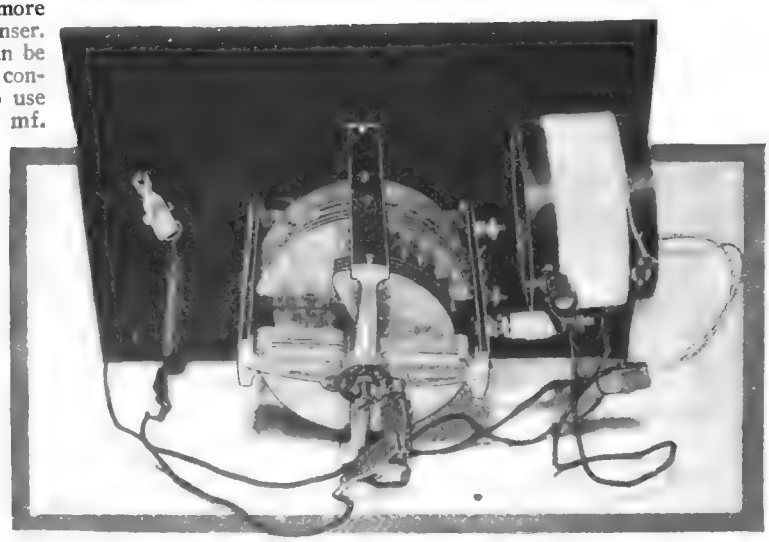
The above diagram shows the different capacity values which can be obtained by connecting together the four sections of the multiple condenser.

THE problem of having a wavemeter which would respond accurately over a range covering from 500,000 to 4,000,000 cycles has always been met with the use of at least two inductive pick-up coils together with a single condenser. Departing from such precedent, this meter was evolved with the view in mind of having a single inductance in combination with a variable capacity of such a value that the resultant device would efficiently cover this large range. The photo above shows the author measuring the frequency of an oscillator with the neon tube glowing brilliantly. As seen in the photo to the right, quick changes can be made in the capacity of the condenser by simply changing the clip leads. Graphs are made covering the more important values of the condenser. In all, eight different values can be obtained from the four-section condenser, but it is inadvisable to use a capacity lower than .000125 mf. This is because of the predominant value of the inductance which when connected to so small a capacity affords practically no change in wave-length. In order to obtain a very accurate check on the frequency, the meter should be calibrated alongside a standard.

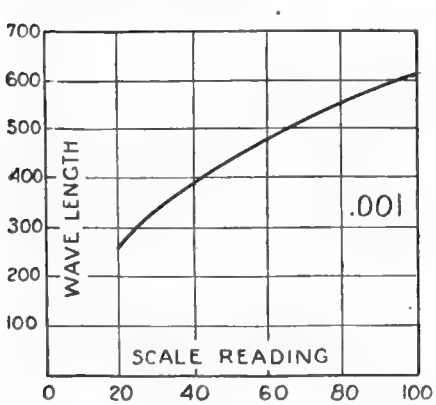
The wavemeter will act very nicely as an absorption circuit for use as a wave trap. The pick-up coil is placed in close inductive relation to the antenna circuit inductance and the condenser is adjusted until the interfering station is eliminated.



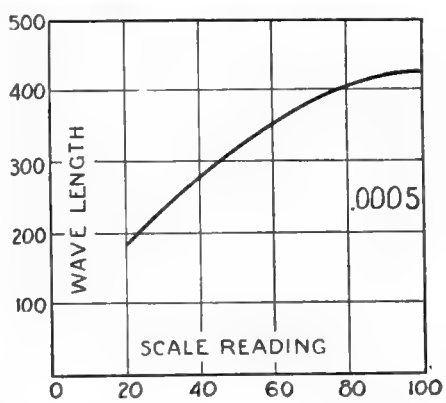
The wavemeter circuit with a neon indicating lamp which glows when resonance occurs.



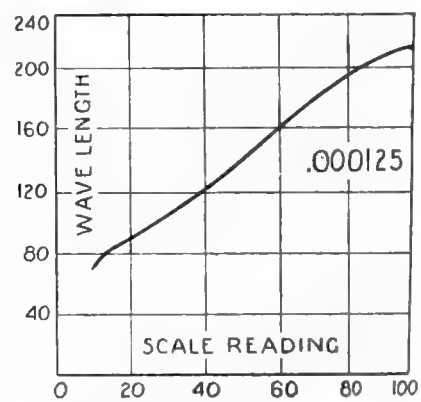
The instrument is mounted on a panel 10 by 7. The inductance consists of 38 turns of No. 22 D.C.C. wire wound on a Bakelite Tube 3 inches in diameter. It is mounted on the panel using two one-inch dowel pins to keep it spaced therefrom. The neon tube is of the ordinary automobile variety which is used in testing the ignition. The dial is provided with a vernier which allows a very fine adjustment. To check up the wave-length of a transmitting station, it is necessary that the pick-up coil be in close proximity to the oscillator inductance. It should then be taken slowly out of the field until the lamp glows very faintly. This indicates resonance.



The above graph represents the inductance in combination with the total capacity of the condenser, .001 mf., covering a range from 260 to 610 meters wave-length.



When using a capacity of .0005 with the inductance, the wave-length range is from 190 to 425 meters. Above this value, the combination does not give an accurate reading.



The transmitting amateur will be very much interested in the above graph since it efficiently covers a very important range on the shorter waves of 70 to 215 meters.

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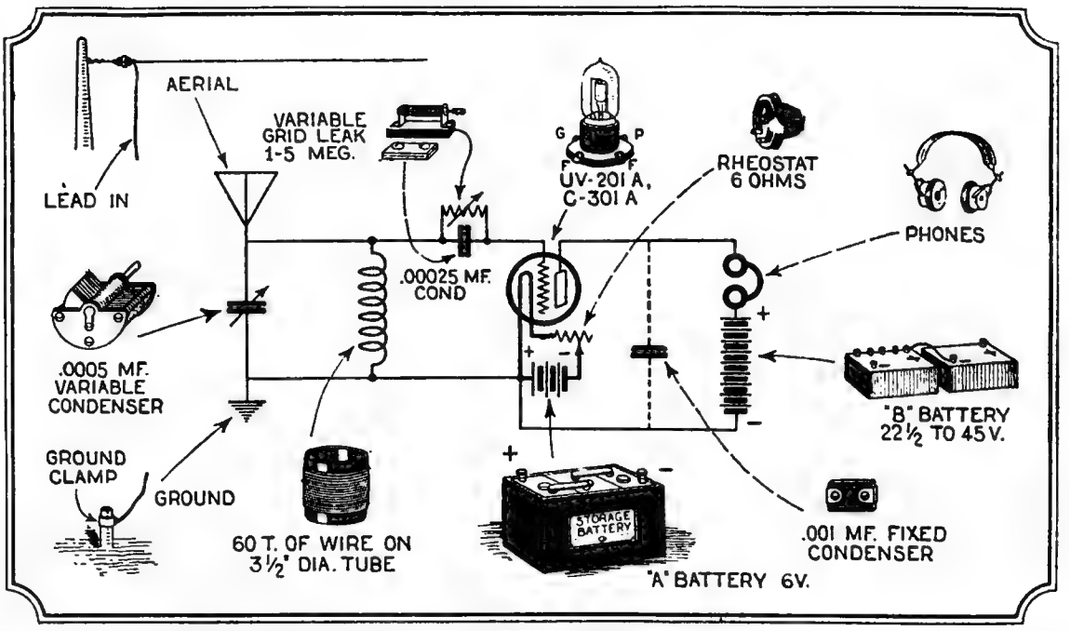
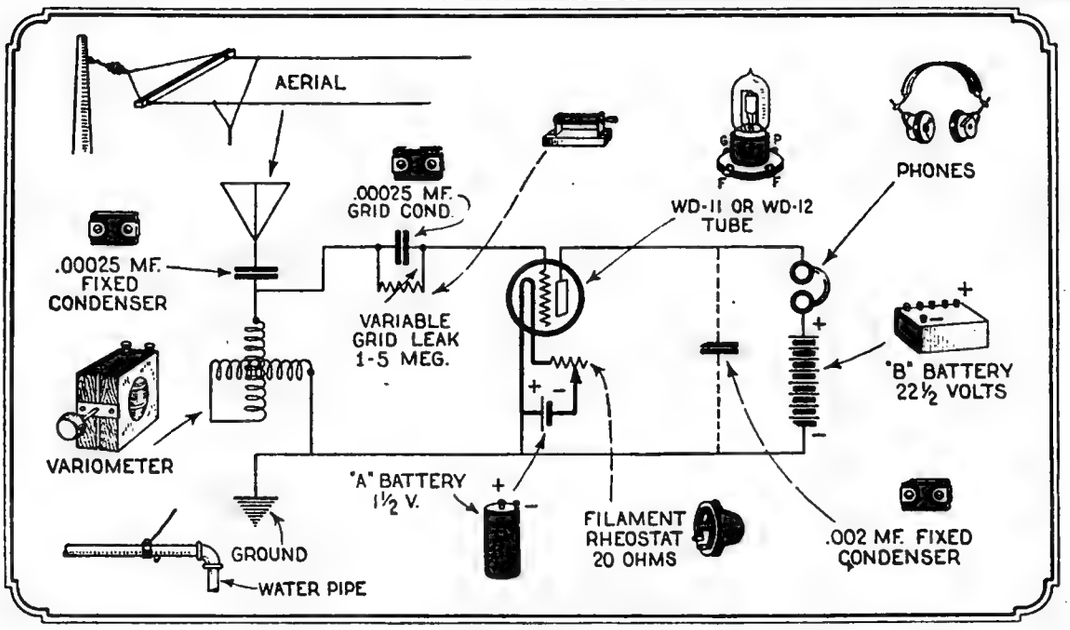
A Page for the Novice

PART III

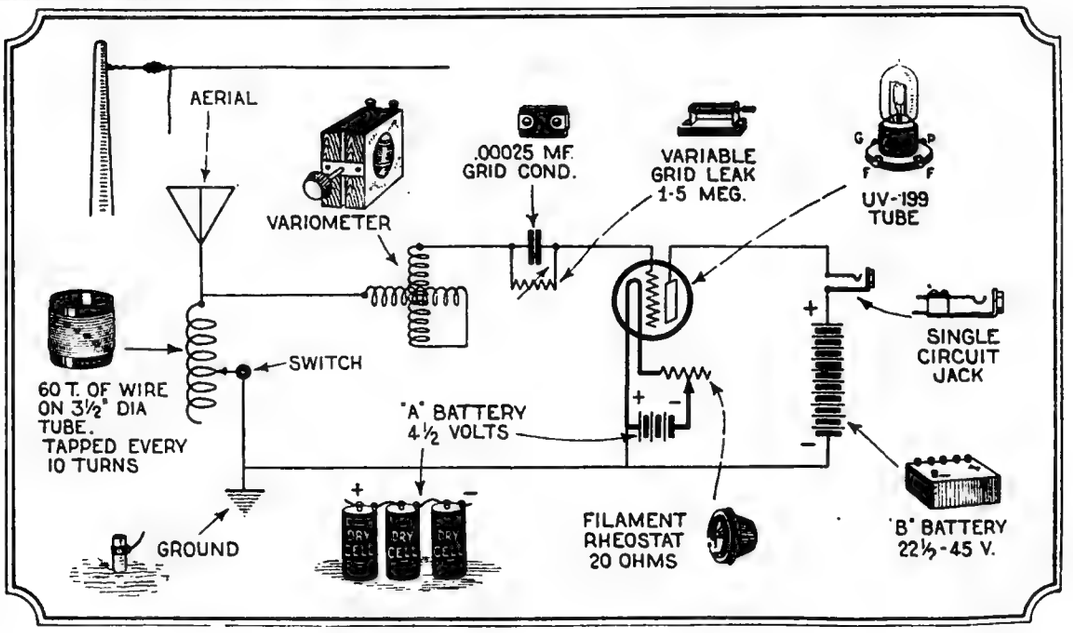
The three element vacuum tube in its simplest hook-up is shown on the right. Analyzing the circuit, the antenna a wire about 100 feet long and suspended from insulators at least 25 feet from the ground, collects the radio frequency waves radiated through space from the transmitting station. The ground connection completes the circuit. Tuning is accomplished by means of the variable condenser placed across the induction coil which, in the last analysis, is merely a concentrated form of antenna. In other words, it would be feasible, if the mechanical arrangement would allow, to use a single wire which could be reeled in and out to correspond with the wave-length range desired to be received. Such a wire would have to be several times longer than the average now being emp'oyed, approximately 1,000 feet long for a 450 meter wave. It will be noted that three diffe-ent methods of tuning are used, and that the three different typ-s of tubes are incorporated in the circuits. If desired, the tubes can be interchanged, remembering to alter the filament circuit accordingly.





In the diagram at the left can be seen a series fixed condenser in the aerial circuit. This is to cut down the wave-length which is caused by using too long an aerial Its interposition does not affect distant reception or signal strength. In fact, it is best to use a long aerial which collects more energy and to place a series condenser either of the fixed or variable type in the antenna or ground leads. However, this cannot always be consumated because if situated in a location where there are a number of stations, interference is bound to result. By interference is meant the reception of several or more stations at one time without being able to tune them out at will. It is surprising to note what added advantage the use of a variable grid leak brings when attempting to tune in distant stations. After years of experiment and research, the present day tube has been brought to the point where a variable grid condenser is not a prime necessity. Sometimes, it is advisable to place a by-pass condenser across the phones and "B" battery, as an increase in signal strength will occur.

The rectifying properties of the three element tube are well known, so it will not be necessary to enumerate them here. Stress is placed, however, on the fact that unless the grid return, as it is known, is connected to the positive side of the "A" battery, the full efficiency of the tube as a detector is not realized. What are known as the characteristics of the vacuum tube are directly responsible for this condition. Briefly, the tube is operated at the bend or "knee" of the curve at which place the best rectifying action takes place. In this connection, the "B" battery voltage must be taken into consideration and varied until the incoming signal becomes as loud as possible without producing distortion. The circuits shown on this page are of the non-regenerative type. They will cause no howling or squealing. The volume obtainable from them is not as loud as can be rea'ized from the use of a regenerative set. In the next issue will be shown how to add regeneration to these receivers. It is advisable to memorize the parts of these simple circuits so as to differentiate between antenna, secondary—or grid—plate—and filament-circuits.



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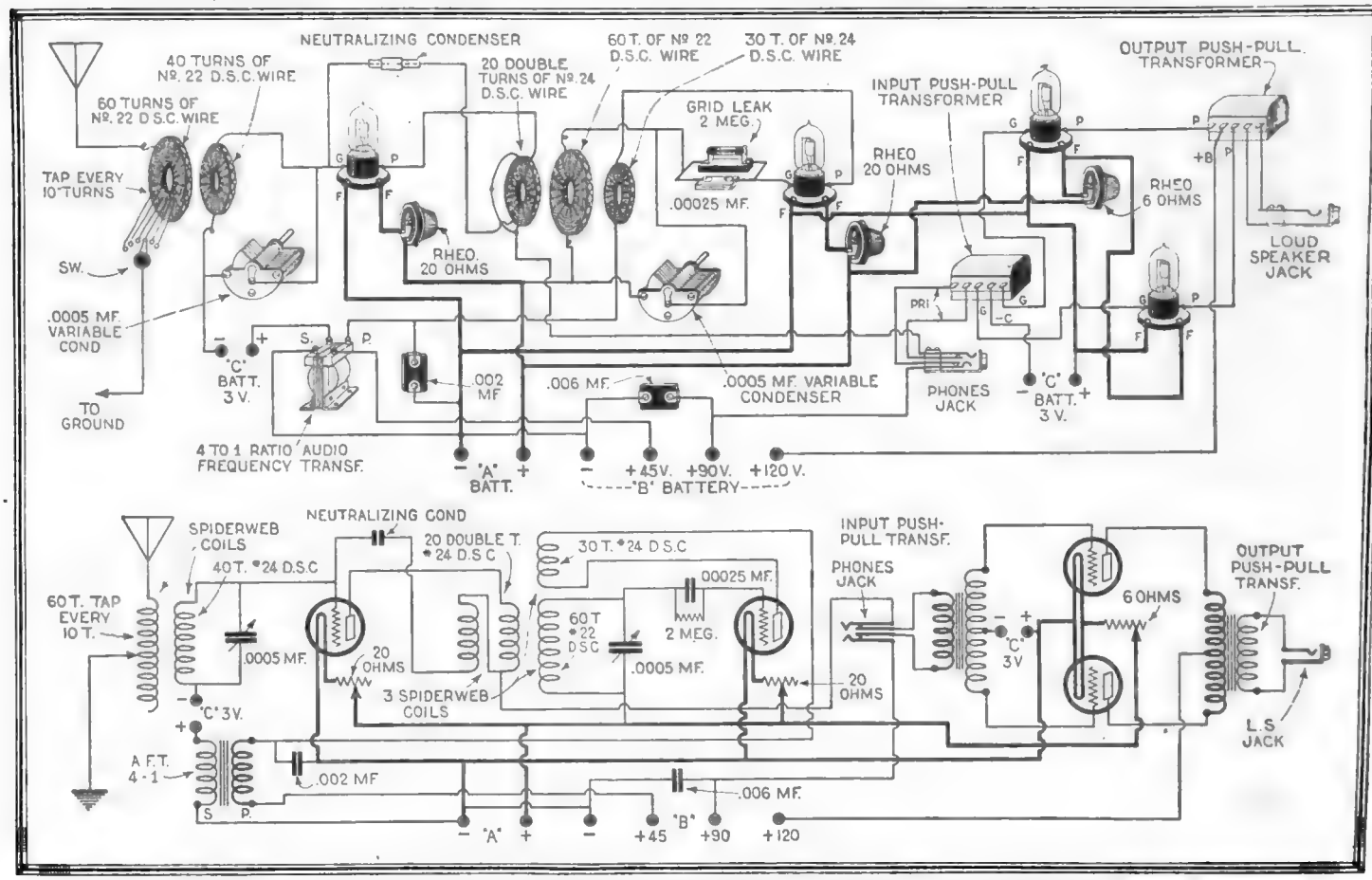
Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c. is made for all questions where a personal answer is desired.



(338) The addition of a push-pull amplifier to the All Circuit Set as described in the November, 1924, issue will greatly enhance its reproductive qualities. This circuit is an entirely new one which is rapidly meeting with favor by all who have constructed it.

ALL CIRCUIT SET

(338) **Albertus King, Syracuse, Neb.,** asks:

Q. 1. "Being very much interested in the set described by Miss L. Port in the November issue, I built it and have received some very wonderful results. Will you kindly publish the diagram of the circuit to which is added a push-pull amplifier?"

A. 1. We are pleased to note that you are also getting good results from your "All Circuit Set." We have received a large number of replies from those who have constructed the receiver, praising its good qualities. The above diagram is, therefore, published with the idea in mind to give those who are somewhat hazy as to its exact construction a more concise explanation of the various details. The addition of the push-pull amplifier does not in any way alter the rest of the circuit. The arrangement consists of a tuned neutralized stage of radio frequency amplification, regenerative detector, reflexed stage of audio frequency and finally the push-pull amplifier which affords excellent clarity and sufficient volume.

Spider-web coils are used throughout merely because they do not take up as much room as the solenoid type of inductance and because their field is more concentrated. Preferably, fibre or bakelite forms about 3½ to 4 inches in diameter and having 17 segments each, should be used. A small brass hinge fastened to one of the spokes allows a variable support. A cam and spring arrangement affords the controlling mechanism which varies the coupling between coils. The neutralizing coil should be fixed in relation to the secondary coil, while the tickler feed-back coil in the detector circuit should be variable in coupling to it.

It is best to use UV-201A or C-301A tubes with this circuit, dry cell tubes giving inferior results. A panel 7 by 21 inches will accommodate the parts very nicely.

TUBES

(339) Martin Solitar, Oshkosh, Wis., wishes to find out:

Q. 1. Whether the "silver" coating on the inside of a tube affects its operation or is a means of determining its value.

A. 1. So many people are under the impression that an unsolved mystery lies in the use of the silvered coating used on the inside of a tube, that they are prone to believe if the coating is not completely deposited there is something wrong with it. This is far from being the case, the so-called silver deposit being a film of condensed magnesium.

In the process of evacuation, which is in itself a very difficult task in view of the fact that even the best air pumps cannot remove sufficient gas, a small piece of metallic magnesium is affixed to the plate of the tube. The plate is then heated using high frequency induction currents. Volatilization of the magnesium takes place, the metallic vapor absorbing the remaining gases, and upon cooling, condensing on the surface of the tube. The condensation does not obey any fixed law as to where most of the deposit will occur, hence its irregularity.

CRYSTAL DETECTOR

(340) Alfred O'Hara, Spokane, Wash., wishes to know:

Q. 1. The exact theory concerning the rectification property of crystal detectors.

A. 1. Although the true action of crystal detectors is a complicated matter, for practical purposes, it is sufficient to regard them as unilateral conductors. This is for the reason that they have a greater resistance to current flowing through them in one direction than to current flowing in the other. Thus, for instance, when an alternating electromotive force is impressed on a crystal detector, more current flows in one direction than in the opposite, and if a direct current meter be inserted in the circuit, it will operate.

The resistance of ordinary crystal detectors is in the order of 1,000 to 10,000 ohms when current is passing in their "low-resistance" direction. The resistance in the opposite direction is about 10 times as great.

WANTED!!! RADIO ARTICLES

WE want descriptions of new radio ideas which you have worked out in practice. Take photographs of the important parts and make pencil or pen and ink sketches of the hook-ups or mechanical details, et cetera. We are particularly desirous of obtaining new hook-ups and descriptions of single tube sets, reflex and other types which have proven satisfactory. We like articles on new single tube receptors. We will pay good prices for your ideas. —Editor.

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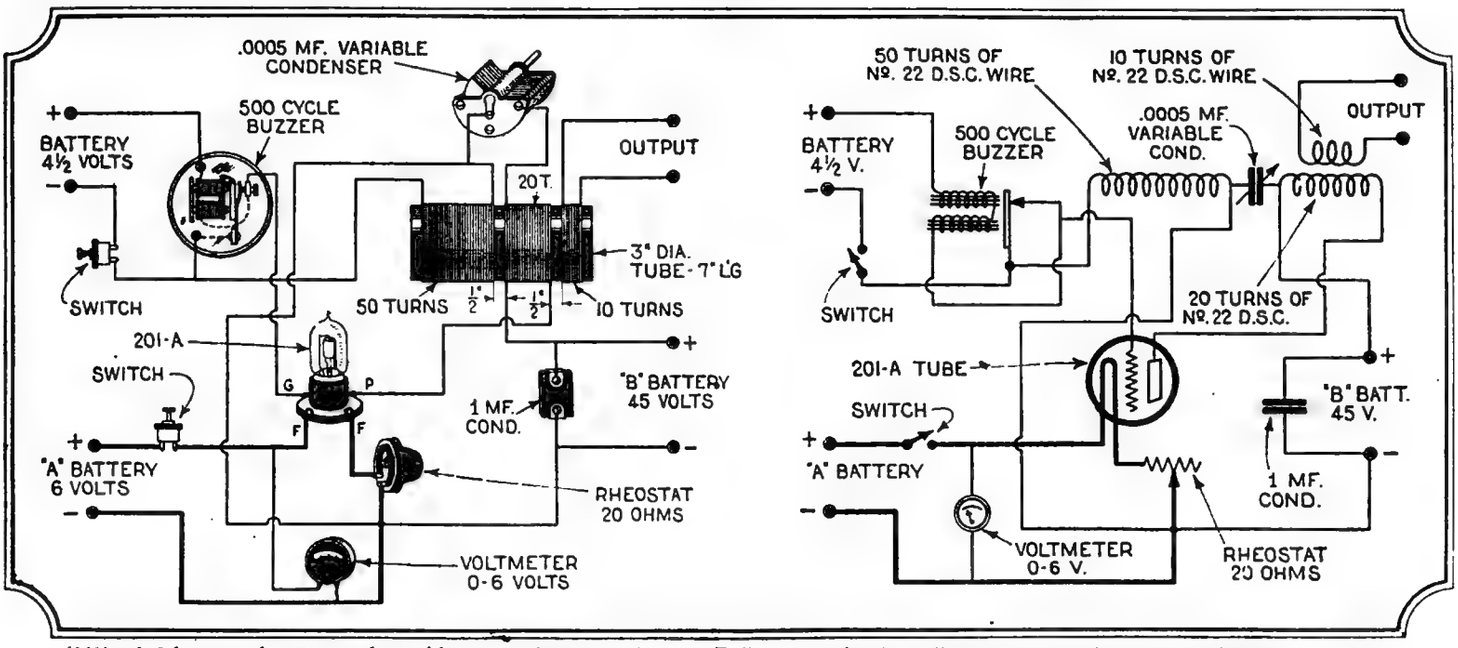

(341) A laboratory is not complete without a calibrated oscillator. Full constructional details are given so that the experimenter can readily build one for himself. The list of material is evident from the picture diagram, a shielded box being used to contain it.

LABORATORY OSCILLATOR

(341) Harry Bertman, Bronx, N. Y., desires:

Q. 1. Information on the construction of a laboratory type oscillator, in which the radio frequency oscillations are modulated by a 500-cycle buzzer.

A. 1. For the numerous purposes to which an oscillator of the type depicted in the above diagram can be put, we are sure that many of our readers will appreciate the constructional data so as to build one for themselves.

To contain the apparatus, a box 16 inches square and 6 inches deep, lined throughout with sheet copper or tinfoil, will suffice. Even the bakelite panel must be thoroughly shielded, provision being made to carefully insulate the wiring against short circuit. The two meters can be mounted flush with the panel or left out entirely.

The first step after the completion of the device is to calibrate it. This should be done very carefully with a standard wavemeter, using the well-known click method. It will be seen that the wave-length range is from 200 to 600 meters, using the constants given. A separate battery is required to operate the buzzer.

The oscillator can, after a fashion, be used as a small transmitter, the amateur always remembering to keep the wave-length below 200 meters. Of course, it is readily observed that the transmitted signal is of the I. C W. type, a key being submitted for the switch in the buzzer circuit.

The real value of the oscillator lies in its adaptability as a means of aiding in the neutralizing and calibration of receiving sets. This is readily accomplished by coupling the exploring coil to the input transformer—antenna circuit—and, having adjusted the oscillator for a certain wave-length, procedure is carried on by tuning the set to resonance and adjusting it to eliminate all squealing. The outfit is known sometimes as a driver circuit.

PROGRESS OF RADIO

(342) William J. Fink, Washington, D. C., asks:

Q. 1. Will you kindly give me information regarding the date upon which radio was first used practically as a recognized means of communication?

A. 1. December 12th, 1901, witnessed Marconi's first attempt at trans-Atlantic radio communication. Listening in near St. Johns, N. F., he was able to pick up the now famous letter "S" broadcast from the 50-kilowatt spark station at Poldhu, located on the southwest tip of England.

It may be, perhaps, interesting to relate some of the experiences which Marconi encountered when he arrived for the preliminary tests.

On December 10 of the same year, four days after his arrival with two assistants, a wireless receiving station was set up and a hexagonal kite made of bamboo and silk was sent aloft over the Grand Banks to hold the antenna wire high in the air. Due to a strong wind which prevailed at the time, the wire snapped and the kite was lost out at sea. Undismayed, Marconi next tried a 14-foot hydrogen balloon, but again the wire broke and tangled up on the ground as the balloon disappeared in a fog.

Undaunted, on the morning of the memorable December 12, another kite was successfully raised to an elevation of 400 feet and at noon the English station, more than 2,000 miles away, was distinctly heard sending the letter "S".

Several days elapsed in which confirmation of the signals was made and, thoroughly satisfied that trans-oceanic transmission and reception was possible, Marconi gave a statement to the press that messages could be sent through space without the use of wires or cables, but also included the rather discouraging remark that this mode of conveying intelligence would have little practical value.

At that time, 24 years ago, but one antenna was to be found in this country with which to pick up the powerful Poldhu station's signal. And now another series of tests were recently carried out with English broadcasting stations in which many hundreds of American radio fans plainly heard programs broadcast from the British Isles. There are now thousands of homes throughout the United States with antennae on their roofs through whose use, joy and pleasure are received. Marconi worked under much greater difficulties than we with our multi-tube super-sensitive receivers and depended upon the erratic action of the old-fashioned coherer; the average broadcast listener of today using a simple crystal detector receiving set is incomparably ahead of the coherer days of 1901. Indeed, in comparison with Marconi's first experiments the simplest sets of today are almost miraculous.

Whereas the commercial trans-Atlantic stations of today use as high as 250 kilowatts of energy, the famous letter "S" was successfully transmitted with but one-fifth this power.

The last figures from official sources show that there are at present approximately 600 radio broadcasting stations in this country alone. Of this number, there are less than a dozen using 1,000 watts of power, about 100 using between 500 and 1,000 watts, while the remainder are composed of stations using as low as a single 5-watter.

DeForest and Fessenden—Read Their Biographies

In the October issue of *Radio News* a biography of Dr. Lee DeForest, inventor of the Audion, was begun. This biography will run for 12 months in *Radio News* and we hope all SCIENCE AND INVENTION readers will read this important work by the famous inventor. Prof. Reginald A. Fessenden's biography began in the January number.

ARTICLES APPEARING IN THE APRIL ISSUE OF "RADIO NEWS"

The Eclipse and Radio Reception. By G. C. B. Rowe.

The Grid as Traffic Regulator. By Sir Oliver Lodge.

The Effect of the Atmosphere on Radio Waves. By Prof. J. M. Guinchant.

Underground Radio. By S. R. Winters.

A Year's Work Below Forty Meters. By John L. Reinartz.

The Latest in Tuned Radio Frequency. By Arthur Reed.

About Radio Losses. By Wilfred Taylor.

Building Compact Super-Heterodynes. By D. J. Hall.

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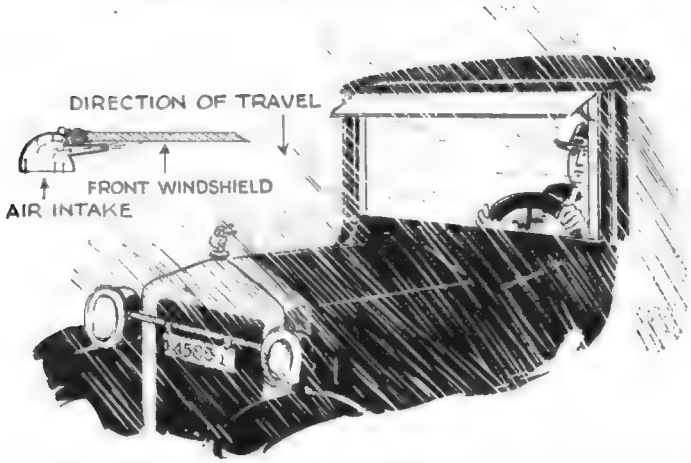
Windshield Cleaner



No. 1,517,365, issued to W. Kleine deals with a novel type of windshield cleaner which uses no mechanical or electrical means for keeping the windshield of an automobile clear of rain and snow. Two air intakes such as illustrated in the insert above are mounted, one on either side of the windshield. The draught of air thus forced across the glass prevents the accumulation of snow or moisture thereon.

Automatic Telescope

No. 1,517,731, issued to C. R. Johnson, covers a novel type of telescope through which a person may view various distant objects by merely inserting a coin in a slot and pressing a button. The coin releases the button which, when pressure is applied, forces to one side a slide which normally obscures the view through the telescope, enabling the patron to look through the instrument. A suitable pivoted base is provided.

Cigarette Holder

No. 1,517,934, issued to C. E. Anderson, protects a novel type of cigarette holder designed for use by those who do not desire to have their fingers stained by the tar of cigarettes. The device is in the form of a finger ring which fits on the first index finger and to which is fastened a clip for holding a cigarette in the desired position. This should interest the modern woman.

WANTED

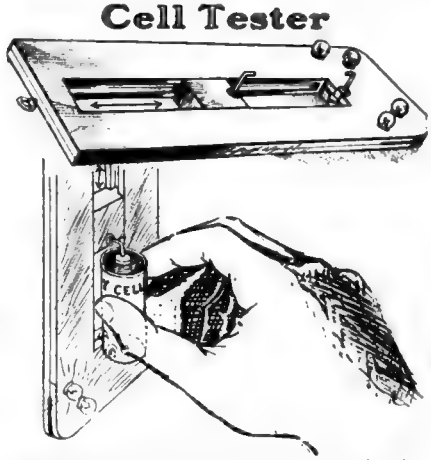
ARTICLES pertaining to automobiles such as handy kinks, roadside repairs and anything of interest to the man who drives a car. $50.00 in prizes every month are offered by MOTOR CAMPER AND TOURIST for such articles. Get a copy at your newsstand and see what is wanted. If your newsdealer cannot supply you send for free sample copy to:

MOTOR CAMPER & TOURIST
53 Park Place,
New York City.

Cable Support

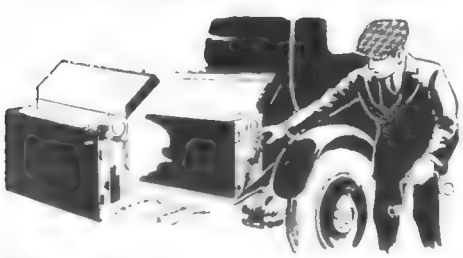
No. 1,516,781, issued to O. F. Nylen, describes a movable clamp for holding the cable connecting electrical instruments in such a manner that the cable cannot become sharply bent and thereby possibly broken. The device consisting of an arm and two clamps is illustrated in detail above. It is of great value in connection with instruments which are constantly being moved about as is an electric pressing iron.

Cell Tester



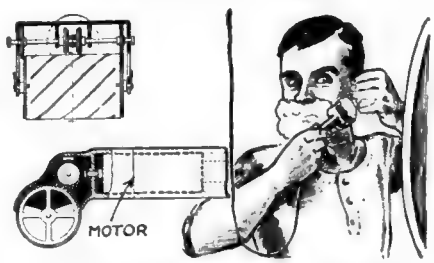
This new patent covers in detail a device for testing small dry cells and batteries such as are used in flashlights. A sliding contact member touches the carbon or positive pole of the battery, while a stationary contact connects with the zinc or negative pole. A sliding contact on the movable block connects the point on that block with different lamps located on the end of the board. These contacts are so placed that a battery of a certain strength will energize a bulb of its own voltage.

Automobile Trunk



No. 1,514,885, issued to F. A. Bigler, relates to an improved trunk to be mounted on the rear of automobiles. This container is provided with a compartment at one end in which tools for use on the car are to be stored. The remainder of the trunk is devoted to the carrying of various travelling necessities. A double purpose is thus served by a single container.

Electric Razor



No. 1,504,311, issued to C. F. Bailey describes a new type of rotary electric razor. A small motor is contained in the handle through which a series of gears rotates a cylindrical blade. The slots in this blade are sharpened on one edge and so designed as to remove the hair without danger of cutting the skin.

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Scientific Humor

A MATCHLESS MAID

TEACHER: "Willie, can you tell me how matches are made?"

WILLIE: "No, Ma'am. But I don't blame you for wanting to know."

TEACHER: "Why, what do you mean?"

WILLIE: "Why, Mother says you've been trying to make one for over a year."—*H. Earl Ballantyne,* Reporter No. 17042.

IS IT 20,000 FEET IN THE AIR?

In the "Liberty," Dec. 13, 1924, may be seen the following sentence — From the Czecho - Slovakian:

"And yet those are the odds of aerial guns everywhere in the war departments of the world today against twenty thousand foot airplanes." Gosh! but ain't science wonderful.—*Conrad Philbreck.*

ANY RELATION OF THE ORANG OUTANG?

Two young girls were watching the kangaroo cavorting about his pen at the Park Zoo. One of them asked, "What is that animal?"

Her friend replied, "Oh, that is one of them Australian Boomerangs."—*Jack L. Baker.*

DEWEY PLUGGED A CAVITE (CAVITY)

JACK: "Gee, you might think a dentist was a civil engineer."

JILL: "Well, he may do a certain amount of bridge-work, but he's not so civil about it."—*I. H. Rothenberg.*

SOME JOKES ARE PETRIFIED

TEACHER OF ANCIENT HISTORY: "Why do we call the first period of civilization the stone age?"

JOHN: "Because it existed such a long time ago that it has become petrified."—*Clarence Tibbs,* Reporter No. 17,314.

QUITE A COME-DOWN

MEDICAL PROFESSOR: "What is the first thing you would do if a patient of yours were blown into the air by an explosion?"

MEDICAL STUDENT: "Wait for him to come down."—*H. Earl Ballantyne,* Reporter No. 17042.

WITHIN THE LAW

OFFICE GROUCH: "There is only one way to make aviation safe."

HIS FRIEND: "Yeh; what's that?"

OFFICE GROUCH: "Have some good lawyers prove that the law of gravitation is unconstitutional."—*Jack L. Baker.*

A SLIPPERY SUBJECT

JACK: "I read that they are grafting rubber-plants in banana trees."

JIM: "What for?"

JACK: "To make non-skid banana peels."—*Peter G. Nickles.*

MY STARS

SON: "Dad, did you ever ride on stars?"

DAD: "No, Sonny, why did you think so?"

SON: "You told yesterday about people hitchin' wagons to 'em."—*Wm. Dressin.*

First Prize $3.00

A FAIR CONCLUSION

PROFESSOR: "And what has chemistry given us?"

STUDE: "Most of our blondes." — *Abe Maves,* Reporter No. 17592.

HE WAS POSITIVE

NUT: Judge Spark is a human dynamo. He electrified the courtroom in his opening speech."

TUT: "What's he doing now?"

NUT: "Charging the jury."—*Frank Smith.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, beside the first prize of three dollars for the best jokes submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

DID IT FRACTURE HIS CRANIUM?

AMERICAN: "Yeh, my poor friend Pat was killed by a revolving crane."

ENGLISHMAN: "My, wot fierce birds you have in America."—*Paul A. Flanagan.*

A CHIMNEY POT HAT OR A JACK POT?

DEALER TO PROSPECTIVE BUYER: "Can I sell you one of these new style plugs?"

CUSTOMER: "No, I haven't the jack."—*Robert H. Lyman.*

APPLIED CHEMISTRY

TEACHER TO FLAPPER: "What is the symbol for platinum?"

FLAPPER: "Engagement ring!"—*Hilda Carroll.*

KEEP US AWAKE

AUNT: "Wonder what makes me sleepy when I listen in?"

ANNA: "Probably the ether."—*Stanley Rider, Jr.*

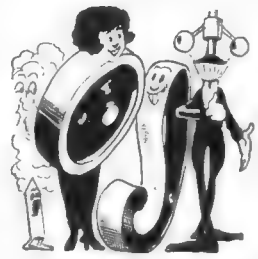
THE SELL WAS ON DARIUS

The Freshman Science Class had been discussing the gravity, or Daniell's cell.

"Now," said the Professor, "can anyone give me another name for the Daniell cell?"

All was quiet for a moment, then a voice from the back of the room replied: "The Lion's Den."—*Julia M. Sharp.*

THE FAST SET



The engine room woke up.

"Say," said Steam, "that's a fly wheel you've been running around with."

"Well," said the Governor, slowly, "is that any call for you to pop off?"

"Pouff, pouff," broke in Smokestack, "don't come to blows! Of course, he's a fly wheel, but anyone knows that the Governor can hold him down. Let him chase 'round with him, who cares?"

"I run 'round with him too, and he doesn't hurt me," said the belt, feeling himself slipping.

"Yeah, Belt's stuck on him," said the Resin.

"Who-o-o-ee! so that's it," said the whistle sarcastically. "Not worth gettin' steamed about! I'm tired—toot, toot;" and with this he pulled the crown sheet about him and went to sleep.

"Oil right, oil right!" said the Fly Wheel hastily, "I'll promise to cut out this fast life"; and the quarrel ended.—*C. S. Garrison.*

SOMETIMES A PLUG HAS TO PULL IT

BILL: "Say do you know an easy way to find the horse-power of a car?"

JONES: "No. How?"

BILL: "Just lift the hood and count the "plugs."—*Robert E. Conrath.*

IS MARRIAGE A SAFETY MATCH?

TEACHER: "What are safety matches?"

STUDENT: "Safety matches are matches that can be used on all occasions, like investigating a gas leak, etc."—*William D. Hoy,* Reporter No. 16951.

CAN'T YOU INVENT ANOTHER?

YANK: "Compose a sentence containing the word 'invention'."

DUTCH: "Mine neighbor's son, Chon, clapped at mine door. I say, 'Come in.' Vell, *in vent Chon.*"—*Abe Maves,* Reporter No. 17592.

SUCH IS LIFE

In many parts of Mexico, hot and cold springs are found side by side. One can see native women boiling clothes in a hot spring, rubbing them on a flat rock, and rinsing them in a clear, cold spring.

A visitor watched this process for some time and then said:

"I suppose the natives think Old Mother Nature pretty generous, eh?"

"No, senor," replied his host, "There is much grumbling because she supplies no soap."—*John W. Skeen.*

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Awards in $1000 Monthly Contest

The Regular Departments Pay Prizes of Their Own. Authors on Contract Receive Their Own Rates; this, With Other Special Payments Makes the Total Paid for Articles in Excess of $1500.00 Monthly.

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(No further entries)

$13,320.00 in Prizes Paid Last Year

WITH the December issue our $12,000 a year prize contest came to a happy conclusion. Not only did we pay out $12,000 in prizes as announced in our November, 1923 issue, but we did actually pay out in prizes alone, not less than $13,320.00 to 1,112 winners. These prizes every month ranged from the first prize of $100.00 down to the smallest prize winner of $1.00 each.

Up to the time of going to press, SCIENCE & INVENTION had no less than 19,000 reporters scattered over every section of the globe. These reporter-contributors have sent in an avalanche of material, and their efforts have been fruitful in that they have won prizes.

SCIENCE & INVENTION aims to print the news first, if it is interesting and to otherwise excel in the reporting of science and invention. Small wonder then that with the enthusiastic co-operation of our thousands of Reporter-Correspondents, SCIENCE & INVENTION today occupies an enviable position in the scientific press.

The $12,000.00 prize arrangement has worked out so satisfactorily during the year just closed that we have decided to extend it for another year and we hope that our correspondents will be as successful in winning prizes for the coming year as they have been during the past one. We wish to thank all of our friends for their co-operation and wish them the best of luck for the coming year.

Note New Prize Schedule.

Here Is How You Can Get in the Contest:

$12,000 or More in Gold

EVERY month SCIENCE AND INVENTION pays $1,000 or more in gold in prizes. Every text article published will receive a prize—(most of the departments have awards of their own which they give every month). Ideas are what the Editors want. The ideas must be told simply, so that your mother or your sister can understand them—in pictures or sketches or both. But the idea must be new and must have something to do with science or invention.

The Editors want pictures and sketches—must have them—but what they want most

82 monthly prizes will be given as follows:

FIRST PRIZE $100.00
SECOND PRIZE $75.00

2	PRIZES OF	$50.00	each	
3	"	"	35.00	"
5	"	"	25.00	"
5	"	"	20.00	"
10	"	"	15.00	"
15	"	"	10.00	"
10	"	"	5.00	"
15	"	"	2.00	"
15	"	"	1.00	"

$12,000 or More in Gold

is IDEAS. These ideas will be handsomely paid for. We have published a pamphlet showing the rules of the contest which we shall be glad to send to anyone free on receipt of a postal card with your name and address. The pamphlet gives full details, the rules and how to submit articles. The magazine itself shows you what is wanted. Study it closely and submit your ideas.

The closing date for all prize contributions is the 15th of the month preceding date of issue, *i.e.*, the 15th of April for the June issue, the 15th of May for the July issue, etc.

WILL YOU BE OUR REPORTER?

IN connection with our $12,000 prize contest announced herewith, it goes without saying that you will have to do a little work in order to win a prize. The Editors do not wish to make it hard for you, quite the contrary. We want pictures and ideas and we cannot have too many of them.

Herewith is reproduced our reporter's card. Up to now we have issued over19,000 of these. Note in our awards how our reporters are winning prizes right along. We shall be glad to send the reporter's card free to anyone who makes an application for it. By means of this card you will be able to secure entry into industrial plants, business houses, motion picture studios, steamships, docks, public buildings, etc. This reporter's card will prove an open sesame to you in many instances. Every card is numbered and only one is given to a correspondent. A postal card from you and a request for this reporter's card is all that is necessary to obtain one. It will be sent to you by return mail. With it we will send you a pamphlet giving rules of the contest and how to proceed in order to get photographs, to send in sketches, and other information in order to obtain a valuable prize. Not only will this card help you to obtain material for this magazine, but it will train you to become a news gatherer, and will be the means of helping you to earn a good deal of money during your spare hours.

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Science and Invention

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Doctor Hackensaw's Secrets

(*Continued from page* 1199)

method of working them. Then, seeing that her glance had fallen on one of Doctor Hackensaw's wireless cipher machines, he explained to her how this device could be used to send secret messages.

As he spoke, the young woman became intensely excited and threw back her veil in order to get a better view of the apparatus. Julius looked up at her, and was amazed to perceive one of the most beautiful women he had ever set eyes on. For a moment their glances met, and then the young lady carefully readjusted her veil again.

But she had smiled at him and Julius saw the smile with a thrill of pleasure.

He took the greatest pains to explain to her in detail the working of the cipher machine, and as she ordered two sets, he gave her a practical lesson then and there, making her change the combinations and work the set herself so as to be sure that she understood his directions.

She made one stipulation—it was that Julius should call her up every day at noon and speak a few words to her in order to insure that the apparatus was working properly. It is needless to say that young McMasher, always ready for an adventure, readily gave the required promise.

He had explained to her about the tuning-in. In Doctor Hackensaw's first experiment, it was necessary before sending a message to tune in each of the ten different wave-lengths separately in order to be sure that each wave-length of the receiving set would correspond exactly with the corresponding wave-length of the sending set. In his improved apparatus, however, the machines were so accurately made that one single tuning sufficed to bring all ten wave-lengths in perfect accord with the ten of the other set.

For a week or so, regularly, every day at noon, Julius exchanged secret messages with his beautiful client. At first the messages related principally to the working of the apparatus, but it soon drifted into conversations on general topics. It must be confessed that Julius flirted outrageously with the lady, yet she didn't seem to mind, but answered his lone messages with peals of silvery laughter.

And then one day came a message that made Julius's heart beat high. She told him her set was not working very well and she would like him to come and fix it. As men were not allowed to come into the harem, he was to meet her attendant at the Mosque of St. Sophia, and the attendant would see to conducting him to the lady's palace and smuggling him in. "Above all things be very prudent!" she said; and then she switched off, while he vainly tried to obtain further particulars.

Sharp at the appointed time young McMasher found himself at the door of the mosque. The attendant was waiting, yet appeared not to notice him, but as she walked past him, she whispered:

"Follow me quietly at a distance!"

The affair was beginning to assume all the appearance of the regulation Oriental intrigue, but Julius was ripe for any adventure. He waited until the messenger had gone some distance and then followed her unobtrusively.

It was not a very long journey. Julius saw his guide enter the door of a very fine mansion, and as the door was left open, he followed in, and found the attendant waiting for him. She led him through one apartment after another furnished with true Oriental splendor and at last introduced him into the chamber where the wireless apparatus was installed.

"Your excellency," said the servant, "here is the gentleman."

Evidently Julius's fair customer was a lady of the highest rank. This time she was unveiled, and as she rose from the divan to greet him, Julius perceived that she was even more beautiful than he had imagined. Never before had he seen such a houri.

To avoid showing his embarrassment, Julius approached the wireless set to examine it, but she hastily plucked him by the sleeve and drew him back.

"Hush!" she said. "You must not make any noise, or my father may hear you. He has returned unexpectedly and is in his room. Perhaps, however, you can discover the trouble without switching on the current. If not, you must return to-morrow.

Julius leaned over and examined the instrument, but everything appeared in perfect condition. The young lady stood beside him, watching him, and insensibly Julius's arm began stealing gently around her waist. She did not appear to notice it, so Julius, growing bolder, pressed her to him. Their eyes met, and she yielded gracefully. Her lips and his met in one long sweet kiss, and then she allowed her head to sink upon his shoulder.

They were disturbed by a sudden noise, and looking up Aissa, for that was the young lady's name, or Ayesha, as it is usually Anglicized, perceived her father glaring at her with a glare of 110 Othello-power voltage.

"Ha!" cried he. "So! so! my fine young fellow! Do you imagine you can come into a man's house like this and make love to his daughter, and then escape scot-free? Not if I know myself! Hey, guards, come here! Seize me this dog of an unbeliever, and I'll make an example of him!"

"Quick Julius!" cried the girl. "I will try to hold my father while you escape by the other door. He won't hurt me, but he would kill you if he got hold of you now!"

There was no time to lose, so Julius with a bound flung open the rear door and scrambled downstairs. He heard voices behind him, and his pursuers were so close upon him that in his hurry he went down one flight too many and found himself in the cellars.

There was no possibility of repairing the error, and it seemed hopeless to seek a hiding place here. Nevertheless, it was his only hope, so he entered one of the cellars and perceiving a trap-door in the floor, he lifted it up and was delighted to see a sheet of water a few feet below him.

"The Bosphorus!" he cried gleefully. "I am saved!" For he understood at once that this must be the famous sheet of water that washes the walls of the residences of many of the wealthy inhabitants of Constantinople. Julius was a good swimmer and escape seemed now assured, for it would be mere child's play to swim in the dark to some boat or to some deserted part of the city.

Without a moment's hesitation, therefore, he plunged into the water, pulling down the trap-door behind him. He then started out swimming, but had not gone ten feet when he came to an obstruction—a row of piles planted close together so as to form a wall.

Nothing daunted, Julius swam along this wall, but imagine his consternation when he found himself back at his starting point without having found a single opening in

(*Continued on page* 1240)

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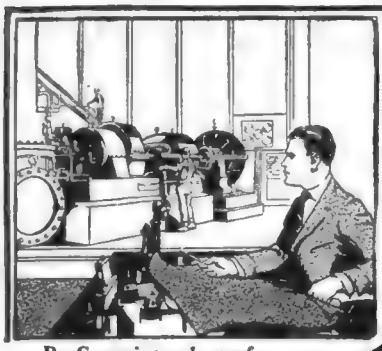

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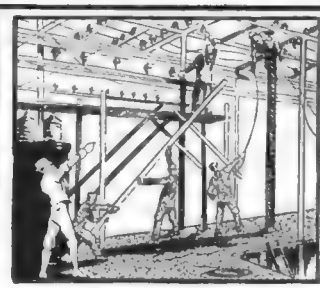

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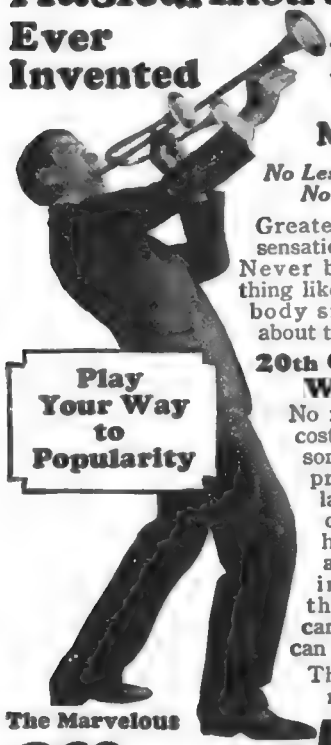

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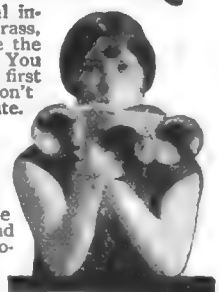

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The Living Death

(*Continued from page* 1240)

At first Frontenac had planned to take a larger party than this.

"Would need more men—many rifles."

Such were the words of Wilkie, written even as his doom was coming upon him. If he could only have set down what that thing was which he saw!

Much deliberation had we had upon the matter—Frontenac, Nunatak and myself—and the result had been Frontenac's decision (which Nunatak and I, all things considered, thought a wise one) that the southern party should be small.

As is usual in such cases, however, there was much to be said on both sides. The element of doubt and uncertainty would rear its head no matter which decision was reached. When it came to the march itself, the advantages were, of course, altogether on the side of the small party. But, when one thought of the Gardens of Paradise and the horror that lurked there—well, matters then assumed a very different aspect, indeed.

Seven men! Captain Livingstone's band had consisted of five (including himself) and its fate had been one awful to contemplate. We should have but two men more; but here entered a factor—and a very important one, too—that at first sight, if the eye were kept on numbers alone, might be overlooked. Forewarned is forearmed. And we had been forewarned. We did not, 'tis true, know what that horror was there in the palm-trees, but we knew that that horror was there, and we would be on the lookout for it and prepared to meet it when it came; whereas Captain Livingstone and his men had never dreamed of the existence of that monster with the enormous claw or of anything like it.

"That knowledge alone," said Darwin Frontenac, "doubles our band. Seven men who know that there is danger and are prepared to receive it when it comes are equal to at least fourteen who are walking right into a trap, so to speak. Though there will be only seven of us, we will, as compared with poor Livingstone's party, number fourteen men."

"That is very true," Nunatak nodded. "And I was just thinkin' what a wonderful savin' there'll be thataway in grub."

"In grub?"

"In grub," quoth Louis Louisiana, "though we'll number fourteen men, and maybe more, there'll only be seven tummies to feed."

"Quite so," Frontenac nodded. "And each of us will be well armed, which was not the case with the others."

"Only seven of us," Nunatak interposed. "Too bad the *other* seven of us can't tote shootin'-contraptions."

"Each man," Frontenac went on, "will have a rifle and two revolvers. And it is upon those revolvers, I fancy, that we shall depend when moving through the gloom of the trees. The revolver, of course, is a better weapon at close quarters than the rifle. That thing with the claw, you'll remember, Bond, dropped so suddenly upon them that they couldn't fire even one single shot with the rifle."

"I remember that. And perhaps it would have been the same thing had the weapon been a revolver."

"Not if each man had had such a weapon."

"You know," I said, "one of the strangest things about that horrible business is why not one of them could get in a single shot."

"I wish," Darwin Frontenac answered, "that that was the only strange thing about it."

He had given the men a careful and detailed account of all that had happened there in the Gardens of Paradise and had ended with a few hints relative to the grisly possibilities that awaited us. This, however, had not produced the faintest sign of the most fleeting hesitation. His words, on the contrary, only made those brave fellows more than ever anxious to go.

Of Sleeping Beauty he had not uttered a single syllable.

There were six sleds; in other words, each man (except Frontenac) had his sled and team of dogs. Each sled—and load, that is—weighed about 900 pounds. There were 90 dogs, 15 in each team. And on one of those sleds we would bring back a stranger load than any vehicle made by man had ever carried—Sleeping Beauty in her coffin of ice.

Coffin! Why, each sled, even now, what with the black provision cases, had an unpleasant semblance to a coffin.

As for instruments, the principal ones were the following: Four thermometers, three aneroids, three hypsometers, five chronometer-watches, two sextants, three artificial horizons and one cinematograph-camera.

That day we made 17 miles and had, I believe, 17 dog fights. I had never seen creatures so surcharged with life as those animals were.

"As full of pep," quoth Numatak, "as ninety sticks of dynamite."

And his remark, forsooth, was a most apposite one.

"But it won't last," the musher added, somewhat ruefully. "It'll be taken out of them, and then we'll wisht that they was peppy once more."

Swiftly now day followed day, and steadily we moved on, deeper and deeper into this terrible region. Though I say steadily, I would not be understood as meaning that there was no interruption whatever in our progress. Once, in fact, we were held campbound for two days by a blizzard. Other delays were met with, too, though slight ones. In no instance besides the one just mentioned did we lose so much as a single day, which, all things considered, was really a remarkable run of luck.

Our camp at the end of the march on the 11th of October was, by dead reckoning (the sky had been overcast for 48 hours) exactly on the parallel of latitude 84°. We were now at the southern edge of that great plain of which Captain Livingstone had spoken and were about to enter the mountains again. Strange thoughts and feelings came to me as I stood and gazed away into those tumbled masses before us. According to Captain Livingstone, Sleeping Beauty lay in latitude 84° 25'—in other words, she was distant now only 25 geographical miles.

I suppose that Frontenac must have known what I thought and felt, for he came and stood beside me and, after a few moments, during which he, too, gazed away to the southward, he said:

"A good day's march would take us to her, Bond."

"That's what I was thinking. I have my doubts, though, that tomorrow's march will be 25 miles."

"I have mine, too. But it won't be long now before we see her."

"Good God," I exclaimed, "what a horrible place to lie in from century to century, from age to age and age again!"

"Yes," said Darwin Frontenac; "a horrible one, truly."

And I thought that, as he stood there gazing at that frozen, terrible waste of snow

(*Continued on page* 1246)

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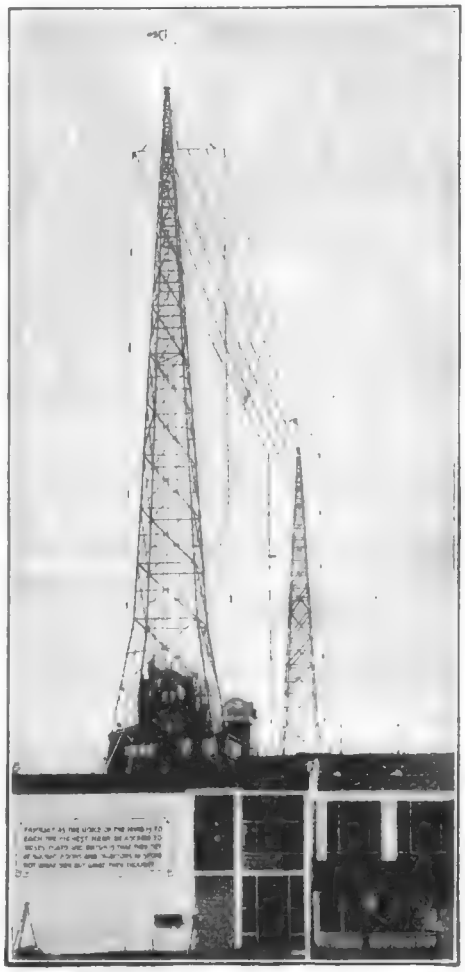

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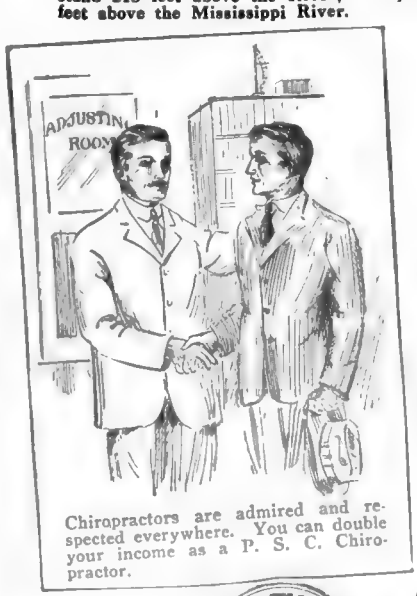

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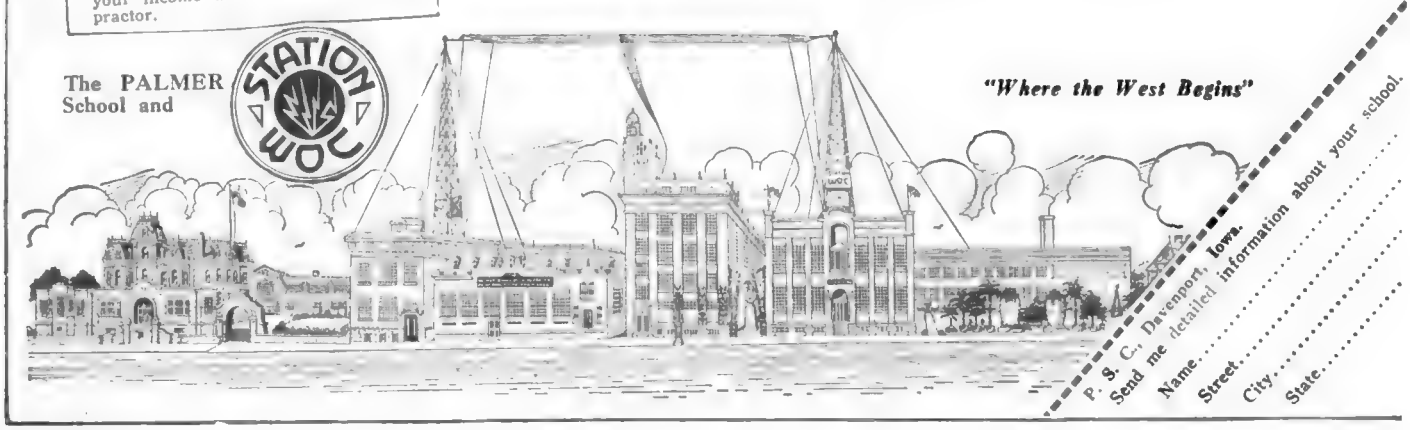

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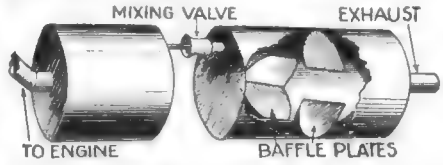
MUFFLER

(880) Howard W. Richards, Toledo, Ohio, has conceived a new type of muffler for use in connection with internal combustion engines, said muffler designed to combine oxygen with the carbon monoxide of the exhaust, producing carbon dioxide, a gas not injurious to human beings. He wants to know whether or not the device is practical.

A. 1. Your proposed device for mixing oxygen with carbon monoxide will not operate in the way you mention, because of the fact that carbon monoxide and oxygen will not combine to form carbon dioxide, except in the presence of extreme heat, or an open flame. The heat of the engine exhaust is by no means sufficient to bring about this union.

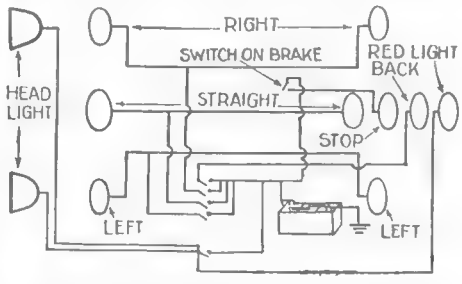


The above illustrated muffler will not mix oxygen with carbon monoxide, thereby evolving a harmless gas, carbon dioxide.

AUTOMOBILE SIGNAL

(881) Joseph H. Furey, Berniser, Pa., submits a design of a system of automobile signal lights upon which he asks our advice. The circuit of the system is given in these columns.

A. 1. We would not advise you to attempt to prosecute your idea at all. It is extremely old and very inefficient. It is entirely too complicated for use on automobiles because of the multiplicity of switches or buttons. The only feature in it that is of any value at all is the stop-light actuated by the foot brake, but this device in itself is completely covered by patents. We would advise you to entirely abandon your idea.



There are entirely too many switches on the above illustrated automobile traffic signal.

COLLAPSIBLE SAWHORSE

(882) H. Nixon, Los Angeles, Calif., submits a design of a folding sawhorse, and asks our opinion on the patentability of the same.

A. 1. There is no doubt but that the sawhorse you have designed is patentable, and it seems to present marketing possibilities. It is absolutely necessary that the device be rigid and quite stationary. We would advise that you have a search made on this idea.

INTERNAL COMBUSTION ENGINE

(883) H. E. Fisher, Montreal, P. Q., Canada, submits a design for a new type of internal combustion engine which is supposed to make the entire unit operate at a higher temperature than the present day type of engine, the excess heat being made to perform further work. We wish to advise Mr. Fisher herewith that our personal answer to him was returned because of the fact that the address he gave us in his first communication was not the correct one. Therefore, we are using these columns to convey our opinion to him.

A. 1. Devices of the nature you mention have been tried in many different ways, but have never been successful. The same would be found with yours.

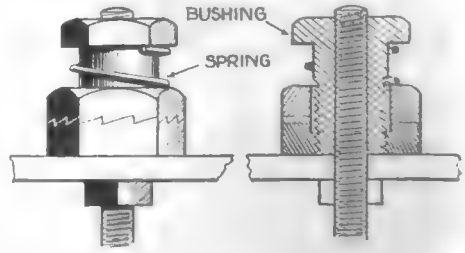
In the first place, the most efficient operating temperature for a gasoline engine is about 178° F. At this temperature the gasoline mixture explodes with the greatest force, and the greatest amount of air can be mixed with the gasoline. When the temperature of an engine goes above this figure, the efficiency of the engine is lowered, and furthermore, lubrication is not satisfactorily carried out.

We do not believe that any device of the nature you suggest would add to the efficiency of the engine, but would in fact detract from the same.

LOCK NUT

(884) J. E. Styert, Detroit, Mich., asks our opinion on the complicated lock nut which he has designed, and which we are illustrating herewith.

A. 1. Referring to your lock nut, we would advise that the system is entirely too complicated for exploitation and would certainly not advise you to attempt to secure a patent upon the same, because we doubt that it could ever be made popular.



The lock nut illustrated above is far too complicated to ever merit a wide sale.

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The Living Death

(*Continued from page* 1242)

and rock, the poor girl, for the first time, became an object other than one of mere scientific interest. And, when he spoke, I saw my thought become a certitude.

"Poor little kid!" is what he said.

During the whole of the following day, the going was very difficult, but we succeeded in making good 14 miles of southing. This was according to dead reckoning, for we had not yet succeeded in getting a single glimpse of the sun. The next morning, however, he broke through the dark curtain and soon was scattering the clouds in all directions. A meridian altitude gave our latitude as 84° 21′. By dead reckoning, it was 84° 17′, which speaks well indeed for the accuracy of our sled-meters.

Only four miles now from Sleeping Beauty.

And by two o'clock we had reached the spot.

Keen and eager were the looks which Frontenac and I sent as we opened that gorge in the mountains. The others, wholly unconscious of the interest that was attached to this place, continued steadily on, the negotiation of the difficult route engrossing their attention.

Frontenac and I halted.

"There it is, Bond!" said he, pointing, then raising the binoculars to his eyes. "There's the cavern mouth, though pretty well filled, it appears, with snow."

For some time we stood there looking and wondering, then pushed on after the others. A half mile or so beyond the place, a level spot, comparatively speaking, was reached, when we halted and made camp—a proceeding, it was patent, that puzzled the others.

Frontenac, however, offered not a single syllable of explanation.

Straightway he, Nunatak and myself headed for the cavern, the musher carrying a spade. It was plain that that spade intrigued Nunatak, but not a word of explanation was vouchsafed him, whilst he did not suffer curiosity to elicit from him the slightest query.

As we were drawing near, he suddenly stopped and stood, peering up.

"Looks mighty like a cave up there," he observed.

"That's what it is," Frontenac told him, "probably the most wonderful cavern in all the world."

Nunatak made no response.

The next moment we had started up. Frontenac was the first to reach the entrance; a few seconds, though, and I was beside him.

"Not a sign of her, Bond," he said, in a low voice.

"It's the snow—the snow!" I exclaimed excitedly.

"Of course."

He turned his head and looked down.

"The spade, Nunatak," he said. "Hurry up with that spade!"

"Ain't I hurryin'?" came the aggrieved answer of the musher. "Do you think, boss, that I'm a spider?

"I uster to think," he went on, "that I was a musher; but the way you fellows sailed up this here place showed me that I was a turtle. If it hadn't been for these crampons, I'd sure enough have broke my neck."

Frontenac and I had started to scoop off the snow with our mittened hands. A few moments, though, and Nunatak was nearing the top. I reached down for the spade; as

(*Continued on page* 1248)

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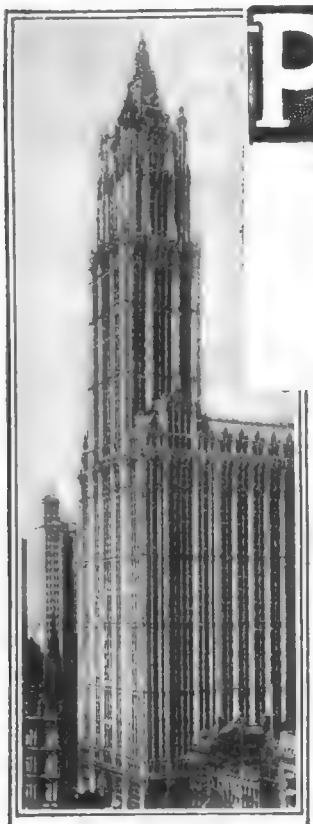

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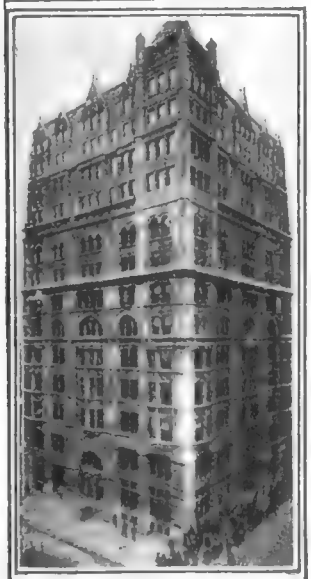

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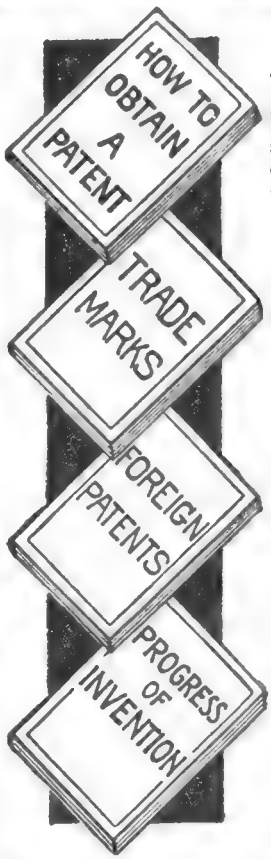

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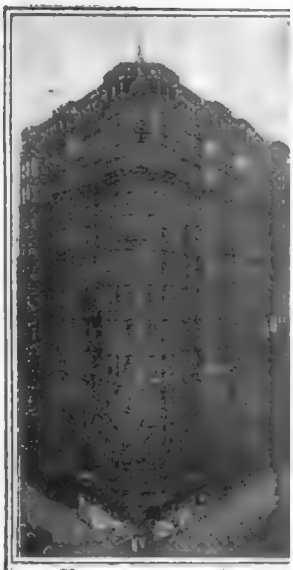

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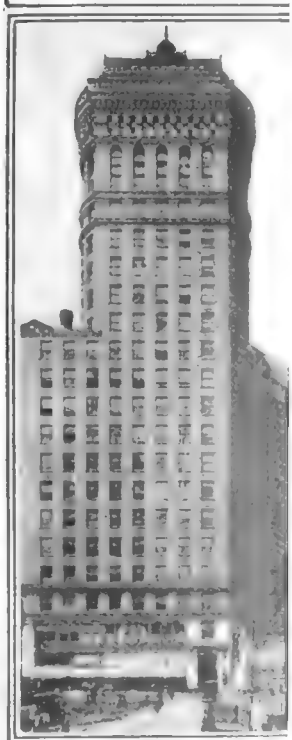

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The Living Death

(*Continued from page* 1246)

I straightened up, it was seized by Frontenac, who began to remove the snow with feverish haste, careful, though, not to dig into the ice.

At this Nunatak could no longer restrain his curiosity—which, indeed, had suddenly become something very like astonishment.

"What," he exclaimed, "are you lookin' for?"

Scarcely had the last word left the musher's lips when an exclamation broke from Darwin Frontenac.

I bent forward to see, my heart beating heavily.

Frontenac dropped the spade and began to dust the snow from the ice with his mitts.

Suddenly he paused—exclaimed again—pointed.

"Look!" he cried. "Look, Bond! *There she is!*"

CHAPTER XXIII

THE SUDDEN VOICE

I had already seen her—or, rather, her head and shoulders, for that was all of the sleeper that, as yet, was visible.

Frontenac dropped to his knees, put his head close to the ice-front and peered in at the girl's face.

Nunatak thrust himself forward to see, his swift movement threatening for a moment to destroy my equilibrium and precipitate me off the spot.

The next instant an exclamation of wonder and horror burst from his lips.

"What awful thing is this?" the musher cried.

To that neither of us made any response.

Darwin Frontenac raised his head and turned his look up to me.

"Her eyes," he said. "Look at her eyes, Bond."

I bent forward and looked—looked straight into the eyes of the sleeper. They were no more than eight inches from the edge of the ice. They were wide open; the long dark lashes were as natural as though it were air and not this paleocrystic ice that incased them, and the pupils were extraordinarily dilated. The iris seemed blue, but whether that was the actual color or not, I could not tell.

"It is horrible!" I said, shuddering. "Horrible!"

"It is wonderful, Bond!" said Darwin Frontenac, bending forward once more. "It is wonderful!"

"I'd say," came the voice of Nunatak, "that McQuestion is right; 'tis an awful sight to see. And 'tis a mystery, too; how on earth did this poor creature get here?"

"She," I told him, "has been here always."

"Always?"

"Ever," I explained, "since the snow and ice fell upon the Antarctic."

He stared at me for some moments.

"What you talkin' about, McQuestion?" he exclaimed.

"I know what I am talking about. Look at her dress; it is almost tropical. She has been here for thousands upon thousands of years. No man living can say how long this poor girl has been lying here—here in her coffin of ice."

"Coffin!"

The next instant Nunatak's hand had closed on my arm with convulsive strength.

"A coffin!" he cried. "McQuestion, tell me this: Do you think that she is like them poor dogs was before he woke them?"

I nodded.

"The probability," I told him, "points in that direction."

(*Continued on page* 1250)

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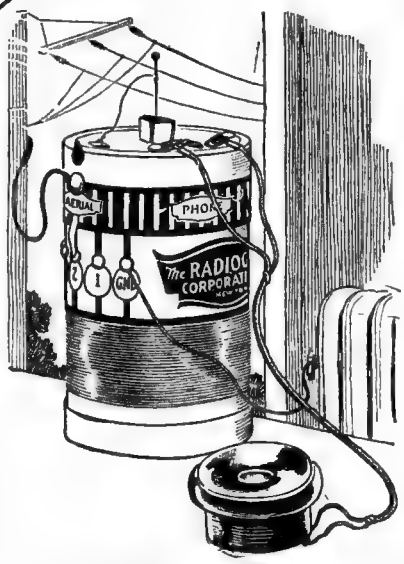

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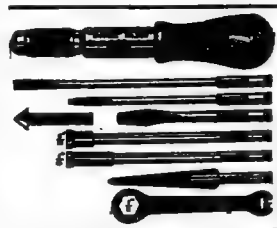

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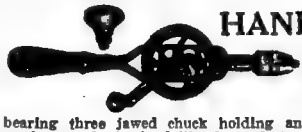

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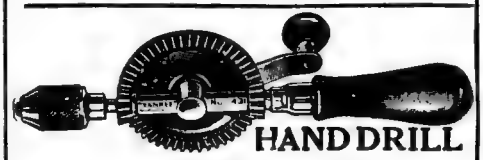

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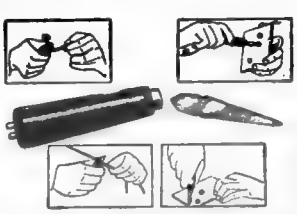

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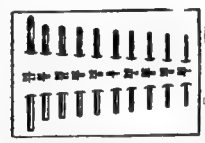

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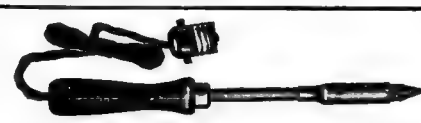

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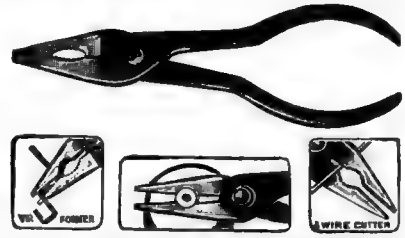

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The Living Death

(*Continued from page* 1248)

He turned his look to Darwin Frontenac, who had arisen and was once more removing snow, so as to obtain a view of the sleeper's whole person.

"And," the musher said, "you are goin' to wake her up, boss—wake her up just like you did them poor dogs?"

Frontenac paused, and for a moment or two looked at the other with a curious, abstracted expression on his lean face.

"Such, Louis, is my hope," he said. "Yes, I am going to awake her."

"But——"

"Well?"

"Even you, boss, can't waken dead people. This purty darlin', her heart is still and frozen; the poor girl is dead."

"She may be, Louis, and she may not be. No one can tell that—now."

"I can, boss."

"A man," Darwin Frontenac added, "can only balance probabilities and base his belief on the result. That is what I have done, and my belief is that the girl, though entombed in this mass of solid ice, is not a corpse."

"She's dead!" said Louis Louisiana. "You awoke them huskies, but you'll never awake this sleeper, boss."

"That," Frontenac answered, a wan smile passing athwart his features, "is just what you said about those dogs, because they lay there stiff and frozen."

"I guess you're right, boss," said Louis Louisiana.

He turned slowly and sank down upon the ice at Sleeping Beauty's feet.

"Great Lord," he said, "what will it be next?"

Soon Frontenac had finished. He stood there leaning on his spade and looking down on the sleeper.

"What you goin' to do?" queried the musher. "Goin' to cut——?"

He broke off and, turning quickly around, peered into the dark mouth of the cavern.

"What's the matter?" I asked.

"I thought that I heard somethin'—in *there.*"

"What?"

"I dunno what. It sounded like a voice."

"A voice?" said Darwin Frontenac.

He laughed.

"Probably an echo of your own."

"I suppose so," the musher said. "That must have been what it was—that or just plain imagination.

"But, as I was about to say," he added, "are you goin' to cut out a block of this ice, a block with the girl inside of it, and take her up to the *Multnomah?*"

"Just so. We'll disturb nothing here, though, until we come back from the Gardens of Paradise."

"That's as I figgered it. You'll take her to the *Multnomah,* and then you'll awake her—if she ain't dead."

"I'll awake her," said Frontenac, "when we get back to Seattle. There are, of course, other reasons why I would never awake this girl here in the Antarctic; but most surely I would never do it unless there was a woman at hand."

"Of course," Nunatak nodded; "I was unthoughtful there."

Frontenac smiled wanly.

"It wasn't the only point, Louis, on which you were unthoughtful."

He sent his look into the cavern. A few moments, and he turned to Nunatak and said:

"Louis, I wish you to return to camp and

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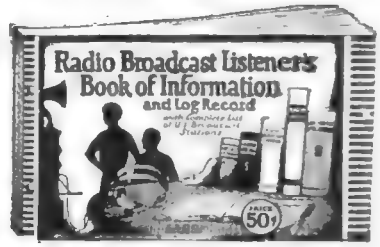

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get those two lanterns. You wondered, I believe, why we were taking along those lanterns."

"I did, boss; but I see now why you brought them."

"And bring that twine, also, Louis. There are two miles of it on that spool."

"Aye, aye, boss. Anything else?"

"Yes; ask the others if they care to come and see the sleeper—and the inside of this cavern."

Louis Louisiana sent a curious look into the low, dark entrance.

"Somethin' in there, boss?"

"Of course. God only knows what. There's a door in there."

"A door! Goin' to open it, boss?"

Frontenac laughed.

"According to the descriptions given by Captain Livingstone, we'd have to have drill or dynamite to see what is beyond that door."

"Then we ain't goin' to see what's behind it."

"And," Frontenac added, "see that none of the dogs follow; fasten them up, every one of them."

"Great poodles, boss! What's the idee?"

Darwin Frontenac moved a hand toward the sleeper.

"There's no telling. If they saw her, they might dig her out."

"I was untoughtful again. 'Twouldn't be puppy-play, that," said the musher; "but they might do it all the same—dig her out and strip her bones, even though she is froze like a rock."

"We'll take no chances, Louis."

"That all, boss?"

"All, I believe," nodded Frontenac.

The musher turned to descend.

"Just a minute, Nunatak," I said. "I want to get a couple of photographs."

These taken, Louis Louisiana started forthwith for the camp.

Frontenac lapsed into brooding silence. I moved up to the ice once more, dropped on my knees and gazed in upon that lovely, awful face—so plain and yet with a strange mistiness about it, so to speak, something like the image upon the ground glass when the focusing of the camera is not quite perfect. And, as I knelt there and looked upon the sleeper, strange, weird, fantastic thoughts and feelings came to me. I could not keep the tears from my eyes. And those words of the man who had found her echoed and reechoed through gloomy, awful corridors in my braid:

"Perhaps you—both of you—will love her, too."

Frontenac laid a hand on my shoulder. I raised my head; his look was upon the sleeper's face, a strange, indescribable expression in his eyes.

"Poor little kid!" he said.

At length came Nunatak and the others. The scene rises before me as I write as vivid as though it had been yesterday—the sleeper there in her bed of cloudy crystal, the men clustered together before the ice and looking in upon her in wonder and in awe.

"Well," said Frontenac, at last, "now that you all have seen her, we will cover her with snow again, then enter the cave. There is a door in that cavern, a massive door of solid rock. We know no more than that, save that the cavern is an extensive one. A full exploration, with the limited time at our disposal, is, in all probability, out of the question."

We were a long time in finding the door, over which that awful carven harpy holds eternal guard; and much we marveled that Captain Livingstone and Hampden had ever succeeded in finding their way out of this terrible labyrinth.

But at last we stood before that mysterious door. What was beyond it?

(*Continued on page* 1253)

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The Living Death

(*Continued from page* 1251)

And that terrible figure up above, more striking by far than the great sphinx of Egypt—why had those men of that dim, nebulous past carved that frightful monster there?

It was a strange scene truly, and one to give a man some eerie thoughts and feelings. There was the mysterious door, the Gorgon figure above it, works of an antiquity so remote that even the imagination grew weary as it moved through those gloomy vistas which—vista beyond vista, and on and on, age to age succeeding—stretched back toward it; and there, standing before this handiwork of an unknown people, we seven men of the modern world, seekers after strange things, enigmas, horrors.

Well, this was one of them—one of all three.

The lanterns cast deep shadows, shadows that assumed monstrous proportions as they stretched away to involve themselves in that Stygian gloom.

Sometimes (as one of the lanterns, or both of them, moved) the shadows would sway, quiver, glide this way and that, rush over floor, lofty vault or walls like disembodied, nameless things.

To show how wierdly and powerfully the scene affected the mind, I felt myself thinking of the men who had designed these things, of those whose hands had fashioned that harpy out of the living limestone rock, pierced the wall and closed the entrance with that massive door of granite—wondered if their spirits ever visited this spot, lingered and watched in this cavern of Erebus. And, so powerful was this thought, I found myself glancing into the shadows and blackness, as though seeking spectral forms and eyes.

We went up to the door and pressed upon it; we might as well have pressed against the wall on either side.

"Funny thing, it seems to me," said Louis Louisiana.

"What," queried Frontenac, "is a strange thing?"

"That there is so little dust hereabouts this door, boss—considerin', that is, that these things have been here for millions of years."

"Millions? You mean thousands of years, Louis."

"Well, thousands, then. Thousands or millions—I don't see as it makes much difference either ways."

"You forget Captain Livingstone and Hampden. See all the dust they removed from the entrance."

"Oh, I ain't forgot that, boss. And here's 'nother thing: I was wonderin'——"

"Well?"

"I was wonderin', boss, if somebody—I mean some *thing*—hasn't been here before us."

"Livingstone and Hampden were here before us."

"That ain't what I meant, boss. I meant before us but *after* Cap Livingstone."

Darwin Frontenac turned quickly, turned so that he stood squarely facing the musher.

"What *do* you mean?" he demanded.

The next instant, however, Frontenac's expression, his whole manner, changed; he laughed a little, as though ashamed of a momentary weakness.

"Maybe you think that I'm *pelton*, boss; but how do you explain that?"

The musher was pointing toward a mark on the cavern floor. Frontenac stepped forward and bent over the impression. The rest of us, too, moved toward the spot.

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"Well," queried Nunatak, and there was a tone of triumph in his voice, "what is your explanation, boss?"

"A very simple one, Louis; this mark was left by the foot of Captain Livingstone or Hampden."

"No, no!" said the musher. "Look at it close, boss. It's different!"

He appealed to me. I bent over it. Surely Frontenac was right. But, as I continued to gaze upon that blurred impression, a doubt crept into my mind. I called myself a fool, though, for even permitting that doubt to enter my brain, to say nothing of letting it linger there. Some man, some thing here after Captain Livingstone and his companion! Why, the thought was preposterous. How, in the name of reason, could any——?

Came a sudden sound behind us—a hollow, horrible *voice*.

CHAPTER XXIV

"AH-CONE-CAWN-GA"

We straightened up and whirled to the direction whence had come that sudden, mysterious, horrible sound. For a few seconds, what with the strong light we had had in our eyes, nothing was visible there in the dense darkness.

"Good God," exclaimed Loomis in accents of horror, and his words came in echoes from the gloomy walls as though spectral beings had rolled them back in fell mockery and fiendish gloating, "what was that?"

"Surely," came the quiet voice of Darwin Frontenac, "it was a human being that spoke."

"If so," Nunatak said, "such a human as no man of us ever heard before."

The next instant he gave a sharp exclamation and began stabbing the air with a crooked finger.

"Look, look!" he cried. "There it comes! See it! What did I tell you?"

The creature was now visible—a quasi-human, fearsome figure.

"Stand together, men," came a hollow voice, that of Hansen. "This is no man! 'Tis something from hell itself!"

The creature's visage could be made out now, though indistinctly—a death's head in which eyes burned with a fierce, smoky, smoldering fire.

"'Tis a human being, boys," said Darwin Frontenac, "a man like ourselves—a man, though, from hell itself."

There could no longer be any doubt, and each of us, I believe, was more relieved than he would have cared to acknowledge: It *was* a human being—such a man, though, as I never had seen in all my life.

He was naked save for a ragged cloth about the loins. A kind of moccasin—now, however, worn and cut to ribbons—incased his feet. His head hung forward, swaying, as he advanced, from side to side with a reptilian motion. The cheeks were hollow, the eyes sunk deep in the sockets; face and body were horrible with dust and gore; the skin was drawn tight over the bones, rendering his appearance skeletal, fearful.

Straight toward us he came—this swaying skeleton that yet was living. His lips were drawn back from the teeth in a fixed and frightful grin. He kept muttering and mumbling—the sounds seeming to issue not from the mouth, but through the very walls of the chest.

On he came until he was within a dozen feet of us. Then he halted and made to raise his right hand on high, his wild, burning eyes fixed on Darwin Frontenac, that horrible voice, now raised to a high pitch, sounding all the while.

But of a sudden the hand was arrested. It began to sink; the fierce light left his eyes; the grinning face seemed to set in a corpse-like rigidity, and the man came pitching forward into the arms of Frontenac.

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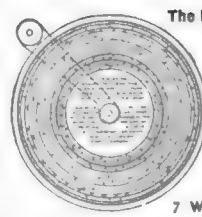

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Frontenac let him sink to the floor, and we turned him onto his back.

"Sheer exhaustion," said Darwin, his hand over the man's heart, "and starvation."

"Memaloose?" asked Nunatak.

"No; the heart still beats, though sluggishly."

"One thing," Nunatak said, "he has been spared the horrors of thirst. He must have got water, else he could never have come to this pass. He would have been dead long ago."

Frontenac pointed to a skin bag (or bottle) at the man's side, carried by a strap passing over the right shoulder.

"A third full," he said, prodding the bag—which gave forth a gurgling sound as it moved—with his finger.

"Funny," said Nunatak, "that he didn't eat the skin. I guess he preferred starvation to thirst. But where did he get the water?"

Frontenac took up the bag, removed the stopper and wet the man's forehead.

"He has been badly wounded here," said Frontenac, indicating the right side of the head. "Must have got it in a fall."

"And there," I said, pointing to the victim's right side. "Clean through the ribs."

"And them ain't the only places," Nunatak remarked. "He is bruised and cut from the top of his head clean to the soles of his feet."

"Poor fellow!" said Frontenac. "'Tis a wonder that he's alive."

"I fear me," said Nunatak, "that he ain't goin' to be alive very long."

"I fear that, too, Louis. But food may do wonders. So go back at once to the camp—thanks to this string, you can go straight to the entrance and in to us again—so go back to camp, Louis, and bring——"

Frontenac paused and turned his look from the musher's face to that of the Antarctican. The eyelids were twitching, the lips writhing back in that horrible grin and the left hand began a spasmodic twitching.

"Coming to," said Watson.

"Or," Nunatak observed, "about to quit this here old Vale of Sorrer."

The eyes of the victim opened. I now saw, for the first time, that those eyes were blue—a bright, wonderful cerulean; yes, wonderful even through that horror which filled them.

He began to speak, his look fixed on the face of Darwin Frontenac.

"He is repeating something," Frontenac said. "Listen to that."

We listened for some moments to that strange verbal repetition.

"What is it?" Frontenac asked.

"*Ah-cone-cawn-ga,*" I told him.

The others nodded.

"That," concurred Nunatak, "is the very word that he's sayin'."

"Or," Frontenac suggested, "words."

"*Ah-cone-cawn-ga!*" said the Antarctican once more, for the first time looking me in the face.

"If," Nunatak exclaimed, "he could only *tell* us!"

The victim suddenly raised himself into a sitting position; almost as suddenly, though, he collapsed back into Frontenac's arms. It was patent that the man's will was in a grim struggle. He raised his skeleton arm and pointed, his lips moving in what, for a moment, I thought was a smile—yes, a joyful smile. The next moment, however, I believed it to be a look of fear and horror. I raised my eyes in the direction indicated by his skeleton finger, and a shiver ran through me as they lighted upon that monster above the door.

"*Ah-cone-cawn-ga!*" said the Antarctican.

The hand dropped to the floor as though the arm had been snipped from the body; the head sank forward, then rolled sidewise in horrible fashion as Frontenac let the corpse sink down to the cavern floor.

(*To be continued*)

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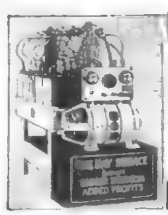

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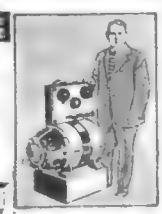

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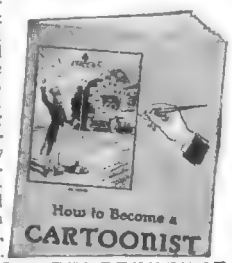

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Scientific Puzzle Answers

(*Continued from page* 1213)

COMPARISON OF TEMPERATURES

Liquids have a tendency to superheat, that is, to get hotter than the vapor that issues from them at the boiling point. This is especially true of liquids in vessels with smooth sides. A dish with rough sides or one containing objects with more or less rough surfaces seems to afford less chance for superheating, for the bubbles of steam form readily wherever there are points or projections, and, with the consequent liberation of heat energy in the steam, the temperature of the liquid is maintained nearer the true boiling point than is the case with vessels having a roughened interior.

THE CARD GAME

Since there are two cards that are alike on both top and bottom, while there is only one card that is different on one surface than on the other, it is evident that, on the average, the former type of card (WW or BB) would appear twice as often as the single oppositely faced (WB) card. Hence the advantage lies with the one who bets that the under surface of any drawn card is like the top.

THE DIFFERENTIAL PULLEY SYSTEM

Let X be the tension of each of the ropes, B and C, when a force of 200 lbs. is applied to A. Then, considering the moments tending to turn the wheel and axle around, we have $200 \times 10/9\ r + Xr = X \times 10/9\ r$ or $X = 2{,}000$ lbs. tension in ropes B and C. But since the pull on the car is equal to the sum of the tensions on the ropes, it will equal $2{,}000 + 2{,}000 + 200$ or 4,200 lbs.

IS THE OBJECT PURE GOLD?

Suspend the object and the nugget of gold from opposite ends of a bar and balance the bar on a knife edge. Then lower the bar until both the gold and the object in question are completely submerged in water. If the bar still balances the object is pure gold, for the moments due to the buoyant force of the water will be the same on each side of the knife edge. If the bar becomes unbalanced by the water it will show that the object is not pure gold.

AN EXPERIMENT IN DIFFUSION

The porus jar which separates the air within it from the air and gas around it will let both gases pass through quite readily. However, the gas from the outside gets in faster than air on the inside gets out because the gas molecules move with greater rapidity than the molecules of air. The result is a temporary increase in pressure within the jar.

CALCIUM CHLORIDE AND IRON SULPHATE

Calcium chloride will apparently increase in weight when exposed to the air because it absorbs water readily from its surroundings. On the other hand, iron sulphate tends to lose water and hence gets lighter.

OSMOSIS

The experiment with the sac of molasses in water is similar in some ways to the one on diffusion described above. In this case the bladder (or other animal membrane) which keeps the molasses and water apart while apparently water-proof will actually let water slowly pass through. It will also let molasses pass through but not as readily. Hence the water gets into the sac faster than the molasses gets out and thus increases the pressure within the sac.

WEIGHT OF IRON OBJECT

Iron objects in the earth's magnetic field soon become more or less magnetized themselves. A "north seeking" pole appears in the lower and northern end and a "south seeking" pole at the upper and southern end. (In this connection try testing the top and bottom of various iron objects, such as radiators, hitching posts, etc., with a compass.) If the intensity of the earth's magnetic field were greater at one pole of the object than at the other the object would be urged downward and northward, or upward and southward, depending on which pole was in a region of greater field intensity. But for objects of ordinary size, the earth's field is constant and hence there is no net force tending to move the object up or down, north or south and, therefore, no magnetic force affecting its weight.

BUOYANCY PROBLEM

By Archimedes' principle, an object more or less submerged in a liquid is buoyed up by a force equal to the weight of the liquid displaced. Since the volumes of the two objects are the equal in this case it might seem that the displacement would be equal for both and, therefore, the buoyant force would be the same for both. But since the open end of the longer can is forced to a lower denth than is the open end of the shorter can, it is evident that air within the former is more compressed than the air in the latter, less water is displaced by it, and hence it requires less force to submerge the longer can.

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First Group of Figures Indicate the Power in Watts in the Antenna of the Transmitting Station. The Second Group Gives the Wave-Length.

Call Letters	Location and Name	Power & Wave Length
KDKA	East Pittsburgh, Pa., Westinghouse Electric & Mfg. Co.	1000—309.1
KDPM	Cleveland, Ohio, Westinghouse Electric & Mfg. Co.	500—270
KDPT	San Diego, Calif, Southern Electrical Co.	50—244
KDYL	Salt Lake City, Utah, Newhouse Hotel	50—250
KDYM	San Diego, Calif., Savoy Theatre	100—280
KDYQ	Portland, Ore., Oregon Institute of Technology	50—360
KDZB	Bakersfield, Calif., Frank E. Siefert	100—240
KDZE	Seattle, Wash., Rhodes Department Store	100—270
KFAB	Lincoln, Neb., Nebraska Buick Auto Co.	200—240
KFAD	Phoenix, Ariz., McArthur Bros. Mercantile Co.	100—360
KFAE	Pullman, Wash., State College of Washington	500—330
KFAF	Denver, Colo., Western Radio Corp.	500—278
KFAJ	Boulder, Colo., University of Colorado	100—261
KFAN	Moscow, Idaho, The Electric Shop	50—360
KFAR	Hollywood, Calif., Studio Lighting Service Co.	100—227
KFAU	Boise, Idaho, Independent School District of Boise City, Boise High School	500—275
KFAW	Santa Ana, Calif., The Radio Den	10—280
KFBB	Havre, Mont., F. A. Buttrey & Co.	50—275
KFBC	San Diego, Calif., W. K. Azbill	5—278
KFBG	Tacoma, Wash., First Presbyterian Church	50—360
KFBK	Sacramento, Calif., Kimball-Upson Co.	100—283
KFBL	Everett, Wash., Leese Bros.	15—224
KFBU	Laramie, Wyo., Bishop N. S. Thomas	50—270
KFCB	Phoenix, Ariz., Nielson Radio Supply Co.	10—238
KFCC	Helena, Mont., First Congregational Church	10—248
KFCF	Walla Walla, Wash., Frank A. Moore	100—256
KFCL	Los Angeles, Calif., Leslie E. Rice, Los Angeles Union Stock Yards	500—236
KFCP	Ogden, Utah, Ralph W. Flygare	10—360
KFCV	Houston, Tex., Fred Mahaffey, Jr.	10—360
KFCY	Le Mars, Iowa, Western Union College	50—252
KFCZ	Omaha, Nebr., Omaha Central High School	50—258
KFDD	Boise, Idaho, St. Michaels Cathedral	10—252
KFDH	Tucson, Ariz., University of Arizona	50—268
KFDJ	Corvallis, Ore., Oregon Agricultural College	50—360
KFDL	Denver, Colo., Knight-Campbell Music Co.	5—226
KFDM	Beaumont, Tex., Magnolia Petroleum Co.	500—315.6
KFDX	Shreveport, La., First Baptist Church	100—250
KFDY	Brookings, S. Dak., South Dakota State College of Agriculture and Mechanic Arts	100—273
KFDZ	Minneapolis, Minn., Harry O. Iverson	5—231
KFEC	Portland, Ore., Meier & Frank Co.	50—248
KFEL	Denver, Colo., Winner Radio Corp.	50—254
KFEQ	Oak, Nebr., Scroggin & Co. Bank	100—268
KFER	Fort Dodge, Iowa, Auto Electric Service Co.	10—231
KFEX	Minneapolis, Minn., Augsburg Seminary	100—261
KFFP	Moberly, Mo., First Baptist Church	50—266
KFFR	Sparks, Nev., Nevada State Journal	10—226
KFFV	Lamoni, Iowa, Graceland College	100—250
KFFY	Alexandria, La., Louisiana College	50—275
KFGC	Baton Rouge, La., Louisiana State University	100—268
KFGD	Chickasha, Okla., Oklahoma College for Women (J. A. Teeters)	50—252

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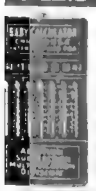

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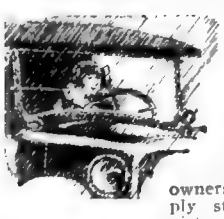

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KGB	Tacoma, Wash., Tacoma Daily Ledger	50—250
KGO	Oakland, Calif., General Electric Co.	1500—312
KGU	Honolulu, Hawaii, Marion A. Mulrony	500—360
KGW	Portland, Ore., Portland Morning Oregonian	500—492
KGY	Lacey, Wash., St. Martins College	5—258
KHJ	Los Angeles, Calif., Times-Mirror Co.	500—395
KHQ	Seattle, Wash., Louis Wasmer (Excelsior Motorcycle & Bicycle Co.)	100—360
KJQ	Stockton, Calif., C. O. Gould	5—273
KJR	Seattle, Wash., Northwest Radio Service Co.	50—283
KJS	Los Angeles, Calif., Bible Institute of Los Angeles	500—252
KLS	Oakland, Calif., Warner Bros. Radio Supplies Co.	250—360
KLX	Oakland, Calif., Tribune Publishing Co.	500—509
KLZ	Denver, Colo., Reynolds Radio Co.	250—283
KMJ	Fresno, Calif., San Joaquin Light and Power Corp.	50—248
KMO	Tacoma, Wash., Love Electric Co.	10—360
KNT	Kukak Bay, Alaska, Walter Hemrich	100—263
KOA	Denver, Colo., General Electric Co.	1000—322.4
KOB	State College, N. M., New Mexico College of Agriculture and Mechanic Arts	500—348.6
KOP	Detroit, Mich., Detroit Police Department	500—278
KPO	San Francisco, Calif., Hale Bros.	500—423
KPPC	Pasadena, Calif., Pasadena Presbyterian Church	50—229
KQV	Pittsburgh, Pa., Doubleday-Hill Electric Co.	500—275
KQW	San Jose, Calif., Charles D. Herrold	50—240
KRE	Berkeley, Calif., Berkeley Daily Gazette	50—275
KSAC	Manhattan, Kans., Kansas State Agricultural College	500—340.7
KSD	St. Louis, Mo., Post Dispitch	500—545.1
KTHS	Hot Springs, Ark., New Arlington Hotel Co.	500—374.8
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KZRQ	Manila, P. I., Far Eastern Radio (Inc.)	500—222
KZUY	Manila, P. I., F. Johnson Elser	500—370
WAAB	New Orleans, La., Valdemar Jensen	100—268
WAAC	New Orleans, La., Tulane University	400—360
WAAD	Cincinnati, Ohio, Ohio Mechanics Institute	25—360
WAAF	Chicago, Ill., Chicago Daily Drovers Journal	200—278
WAAM	Newark, N. J., I. R. Nelson Co.	250—263
WAAN	Columbia, Mo., University of Missouri	50—254
WAAW	Omaha, Neb., Omaha Grain Exchange	500—278
WABB	Harrisburg, Pa., Harrisburg Sporting Goods Co.	10—266
WABD	Dayton, Ohio, Parker High School	5—283
WABH	Sandusky, Ohio, Lake Shore Tire Co.	10—240
WABI	Bangor, Me., Bangor Railway & Electric Co.	100—240
WABL	Storrs, Conn., Connecticut Agricultural College	100—283
WABM	Saginaw, Mich., F. E. Doherty Automotive & Radio Equipment Co.	20—261
WABN	La Crosse, Wis., Ott Radio, Inc.	500—244
WABO	Rochester, N. Y., Lake Avenue Baptist Church (Hickson Electric Co.)	100—278
WABQ	Haverford, Pa., Haverford College Radio Club	50—261
WABR	Toledo, Ohio, Scott High School	50—263
WABU	Camden, N. J., Victor Talking Machine Co.	50—226

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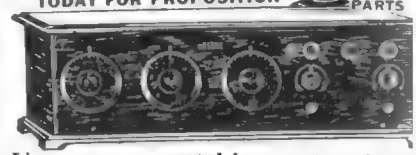

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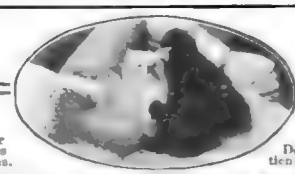

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Call Letters	Location and Name	Power & Wave Length
WABW	Wooster, Ohio, College of Wooster	20—206.8
WABX	Mount Clemens, Mich. (near), Henry B. Joy	50—254
WABY	Philadelphia, Pa., John Magaldi, Jr.	50—242
WABZ	New Orleans, La., Coliseum Place Baptist Church	50—263
WAHG	Richmond Hill, N. Y., A. H. Grebe & Co.	500—315.6
WBAA	West Lafayette, Ind., Purdue University	100—275
WBAN	Paterson, N. J., Wireless Phone Corp.	100—244
WBAO	Decatur, Ill., James Millikin University	100—275
WBAP	Fort Worth, Texas, Worthham-Carter Publishing Co. (Star-Telegram)	1000—475.9
WBAV	Columbus, Ohio, Erner & Hopkins Co.	500—293.9
WBAX	Wilkes-Barre, Pa., John H. Stenger, Jr.,	20—256
WBAY	New York, N. Y., Western Electric Co.	500—492
WBBA	Newark, Ohio, Plymouth Congregational Church	20—226
WBBD	Reading, Pa., Barbey Battery Service	50—234
WBBF	Atlanta, Ga., Georgia School of Technology	500—270
WBBG	Mattapoisett, Mass., Irving Vermilya	500—248
WBBH	Port Huron, Mich., J. Irving Bell	50—205.4
WBBL	Richmond, Va., Grace Covenant Church	100—283
WBBM	Chicago, Ill., H. Leslie Atlass	200—226
WBBP	Petoskey, Mich., Petoskey High School	5 & 100—214.2
WBBR	Rossville, N. Y., Peoples Pulpit Assn.	500—273
WBBS	New Orleans, La., First Baptist Church	50—252
WBBU	Monmouth, Ill., Jenks Motor Sales Co.	10—224
WBBV	Johnstown, Pa., Johnstown Radio Co.	5—248
WBBW	Norfolk, Va., Ruffner Junior High School	50—222
WBBY	Charleston, S. C., Washington Light Infantry	10—268
WBBZ	Indianapolis, Ind., Noble B. Watson	50—227
WBCN	Chicago, Ill., Foster & McDonnell	500—266
WBS	Newark, N. J., D. W. May, Inc.	50—360
WBT	Charlotte, N. C., Southern Radio Corp.	250—360
WBZ	Springfield, Mass., Westinghouse Electric & Mfg. Co.	1500—333.1
WCAD	Canton, N. Y., St. Lawrence University	250—263
WCAE	Pittsburgh, Pa., Kaufmann & Baer Co.	500—461.3
WCAG	New Orleans, La., Clyde R. Randall	50—268
WCAH	Columbus, Ohio, Entrekin Electric Co.	200—266
WCAJ	University Place, Neb., Nebraska Wesleyan University	500—280
WCAK	Houston, Texas, Alfred P. Daniel	10—263
WCAL	Northfield, Minn., St. Olaf College	500—336.9
WCAO	Baltimore, Md., Sanders & Stayman Co.	50—275
WCAP	Washington, D. C., Chesapeake & Potomac Telephone Co.	500—468.5
WCAR	San Antonio, Texas, Southern Radio Corporation of Texas	100—263
WCAS	Minneapolis, Minn., William Hood Dunwoody Industrial Institute	100—280
WCAT	Rapid City, S. D., South Dakota State School of Mines	50—240
WCAU	Philadelphia, Pa., Durham & Co.	500—278
WCAV	Little Rock, Ark., J. C. Dice Electric Co.	10—263
WCAX	Burlington, Vt., University of Vermont	100—360
WCAY	Milwaukee, Wis., Hotel Antlers, Milwaukee Civic Broadcasting Assn.	250—266
WCAZ	Carthage, Ill., Carthage College	50—246
WCBA	Allentown, Pa., Charles W. Heimach, Camegraph Repair Shop	10—254
WCBC	Ann Arbor, Mich., University of Michigan	200—229
WCBD	Zion, Ill., Wilbur G. Voliva	500—344.6
WCBE	New Orleans, La., Uhalt Brothers Radio Co.	5—263

(*Continued on page* 1263)

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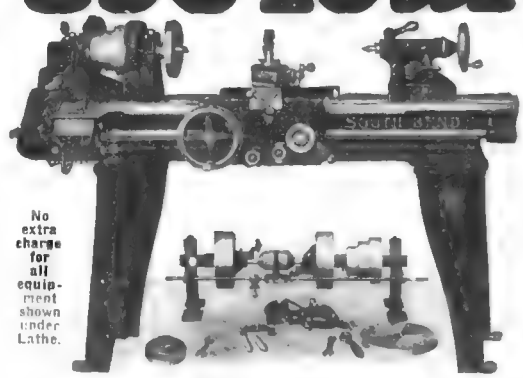

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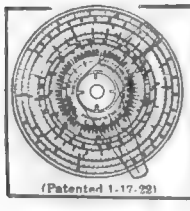

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Radio Broadcast

(*Continued from page* 1261)

Call Letters	Location and Name	Power & Wave Length
WCBG	Pascagoula, Miss. (portable), Howard S. Williams.....	10—268
WCBH	Oxford, Miss. (near), University of Mississippi	10—242
WCBI	Bemis, Tenn., Nicoll, Duncan & Rush	150—240
WCBJ	Jennings, La., J. C. Mans....	10—244
WCBK	St. Petersburg, Fla., E. Richard Hall	500—266
WCBL	Houlton, Me., Northern Radio Mfg. Co.	50—280
WCBM	Baltimore, Md., Hotel Chateau (Charles Schwartz)	50—229
WCBO	Memphis, Tenn., Radio Shop, Inc.	20—250
WCBQ	Nashville, Tenn., First Baptist Church	100—236
WCBR	Providence, R. I. (portable), Charles H. Messter	30—246
WCBT	Worchester, Mass., Clark University	250—238
WCBU	Arnold, Pa., Arnold Wireless Supply Co. (F. J. Ambrose)	50—254
WCBV	Tullahoma, Tenn., Tullahoma Radio Club	10—220
WCBW	Macon, Ga., George P. Rankin, Jr., and Mitland Soloman	10—226
WCBY	Buck Hill Falls, Pa., Forks Electrical Shop	10—268
WCBZ	Chicago Heights, Ill., Coppotelli Bros. Music House...	50—248
WCCO	Minneapolis, Minn., Washburn-Crosby Co.	500—416.4
WCEE	Elgin, Ill., Charles E. Erbstein.	1000—536
WCK	St. Louis, Mo., Stix-Baer & Fuller Dry Goods Co.....	100—273
WCM	Austin, Tex., Texas Markets and Warehouse Department	250—268
WCX	Detroit, Mich., Detroit Free Press	500—516.9
WDAE	Tampa, Fla., Tampa Daily Times	250—273
WDAF	Kansas City, Mo., Kansas City Star	500—365.6
WDAG	Amarilla, Texas, J. Laurance Martin	100—263
WDAH	El Paso, Texas, Trinity Methodist Church (South).....	50—268
WDAR	Philadelphia, Pa., Lit Brothers	500—394.5
WDAS	Worcester, Mass., Sam Waite's Radio Shop	10—360
WDAY	Fargo, N. D., Radio Equipment Corporation	50—244
WDBB	Taunton, Mass., A. H. Waite & Co.	10—229
WDBC	Lancaster, Pa., Kirk, Johnson & Co.	50—258
WDBD	Martinsburg, W. Va., Herman E. Burns	5—268
WDBE	Atlanta, Ga., Gilham-Schoen Electric Co.	100—278
WDBF	Youngstown, Ohio, Robert G. Phillips	50—246
WDBH	Worcester, Mass., C. T. Shear Co.	100—268
WDBI	St. Petersburg, Fla., Radio Specialty Co.	20—226
WDBJ	Roanoke, Va., Richardson-Wayland Electrical Corporation	50—229
WDBN	Bangor, Me., Maine Electric Light & Power Co.	5—252
WDBO	Winter Park, Fla., Rollins College	50—240
WDBP	Superior, Wis., Superior State Normal School	50—261
WDBQ	Salem, N. J., Morton Radio Supply Co.	50—234
WDBR	Boston, Mass., Tremont Temple Baptist Church	100—256
WDBS	Dayton, Ohio, S. M. K. Radio Corp.	5—275
WDBT	Hattiesburg, Miss., Taylor's Book Store	10—236
WDBW	Columbia, Tenn., The Radio Den	20—268
WDBX	New York, N. Y., Otto Baur..	5—233
WDBY	Chicago, Ill., North Shore Congregational Church	500—258
WDBZ	Kingston, N. Y., Boy Scouts of America (Ulster County Council)	5—233
WDM	Washington, D. C., Church of the Covenant	50—234
WDZ	Tuscola, Ill., James L. Bush..	10—100
WEAA	Flint, Mich., Police Building, Frank D. Fallain.....	50—234
WEAF	New York, N. Y., American Telep. & Teleg. Co. 2000	—491.5
WEAH	Wichita Kans., Wichita Board of Trade	50—268
WEAI	Ithaca, N. Y., Cornell University	500—254
WEAJ	Vermilion, S. Dak., University of South Dakota	100—252

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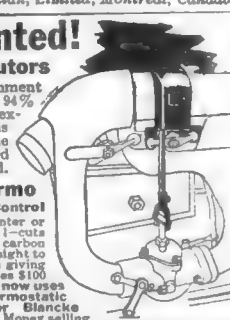

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Call Letters	Location and Name	Power & Wave Length
WEAM	North Plainfield, N. J., Borough of North Plainfield	250—261
WEAN	Providence, R. I., Shepard Co.	100—273
WEAO	Columbus, Ohio, Ohio State University	500—293.9
WEAP	Mobile, Ala., Mobile Radio Co.	100—263
WEAU	Sioux City, Iowa, Davidson Bros. Co.	100—275
WEAY	Houston, Tex., Iris Theatre	500—360
WEB	St. Louis, Mo., Benson Radio Co.	100—273
WEBA	Highland Park, N. J., The Electric Shop	15—233
WEBC	Superior, Wis., Walter C. Bridges	10—242
WEBD	Anderson, Ind., Electrical Equipment & Service Co.	10—246
WEBE	Cambridge, Ohio, Roy W. Waller	10—248
WEBH	Chicago, Ill., Edgewater Beach Hotel Co.	1000—370.2
WEBI	Salisbury, Md., Walter Gibbons	15—242
WEBJ	New York, N. Y., Third Avenue Ry. Co.	500—273
WEBK	Grand Rapids, Mich., Grand Rapids Radio Co.	20—242
WEBL	United States, R. C. A.	100—226
WEBO	Hamilton, Ohio, Harry W. Fahrlander	5—252
WEBP	New Orleans, La., E. Budd Peddicord	50—280
WEBQ	Harrisburg, Ill., Tate Radio Co.	10—226
WEBR	Buffalo, N. Y., H. H. Howell	15—240
WEBT	Dayton, Ohio, Dayton Cooperative Industrial High School	5—256
WEBW	Beloit, Wis., Beloit College	500—268
WEBX	Nashville, Tenn., J. E. Cain, Jr.	50—263
WEBY	Roslindale, Mass., Hobart Radio Co.	10—226
WEBZ	Savannah, Ga., Savannah Radio Corp.	5—234
WEEI	Boston, Mass., Edison Electric Illuminating Co. of Boston	500—475.9
WEMC	Berrien Springs, Mich., Emmanual Missionary College	500—286
WEV	Houston, Tex., Hurlburt-Still Electrical Co.	100—263
WEW	St. Louis, Mo., St. Louis University	100—280
WFAA	Dallas, Tex., Dallas News & Dallas Journal	500—475.9
WFAM	St. Cloud, Minn., Times Publishing Co.	10—273
WFAN	Hutchinson, Minn., Hutchinson Electric Service Co.	100—286
WFAV	Lincoln, Nebr., University of Nebraska	250—275
WFBB	Eureka, Ill., Eureka College	50—240
WFBC	Knoxville, Tenn., First Baptist Church	50—250
WFBD	Philadelphia, Pa., Gethsemane Baptist Church	5—234
WFBE	Seymour, Ind., John Van de Walle	20—226
WFBG	Altoona, Pa., William F. Gable Co.	100—278
WFBH	New York, N. Y., Concourse Radio Corp.	500—273
WFBI	Camden, N. J., Galvin Radio Supply Co.	100—236
WFBJ	Collegeville, Minn., St. John's University	50—236
WFBK	Hanover, N. H., Dartmouth College	100—256
WFBL	Syracuse, N. Y., Onondaga Hotel	100—252
WFBM	Indianapolis, Ind., Merchants Heat & Light Co.	250—263
WFBN	Bridgewater, Mass., Radio Sales & Service Co.	200—226
WFBQ	Raleigh, N. C., Wynne Radio Co.	50—252
WFBR	Baltimore, Md., Fifth Infantry, Maryland, N. G.	100—254
WFBT	Pitman, N. J., Gloucester County Civic League	50—231
WFBY	Fort Benjamin Harrison, Ind., U. S. Army, Fifth Corps Area	100—258
WFBZ	Galesburg, Ill., Knox College	10—254
WFI	Philadelphia, Pa., Strawbridge & Clothier	500—394.5
WGAL	Lancaster, Pa., Lancaster Electric Supply & Construction Co.	10—248
WGAQ	Shreveport, La., Youree Hotel	150—263
WGAZ	South Bend, Ind., South Bend Tribune	250—275
WGBA	Baltimore, Md., Jones Electric & Radio Mfg. Co.	50—254
WGBB	Freeport, N. Y., Harry H. Carman	100—244
WGBC	Memphis, Tenn., First Baptist Church	10—266
WGBF	Evansville, Ind., Finke Furniture Co.	50—217.3
WGBG	Thrifton, Va., Breitenbach's Radio Shop	100—226
WGBS	New York, N. Y., Gimbel Brothers	1000—315.6
WGBT	Greenville, S. C., Furman University	15—236
WGI	Medford Hillside, Mass., American Radio & Research Corp.	100—360

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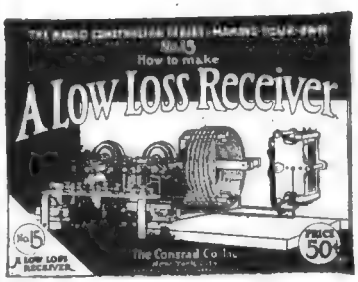

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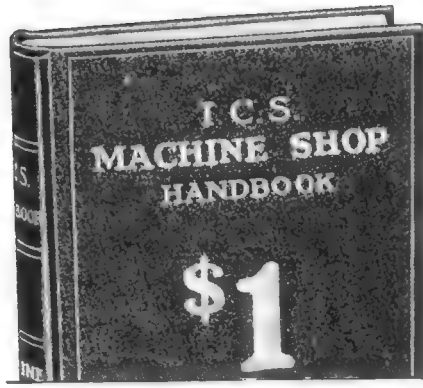
Call Letters	Location and Name	Power & Wave Length
WGL	Philadelphia, Pa., Thomas F. J. Howlett	500—360
WGN	Chicago, Ill., The Tribune (Drake Hotel - Whitestone Co.)	1000—370.2
WGR	Buffalo, N. Y., Federal Telep. Mfg. Co.	750—319
WGY	Schenectady, N. Y., General Electric Co.	1500—379.5
WHAA	Iowa City, Iowa, State University of Iowa	500—483.6
WHAD	Milwaukee, Wis., Marquette University	500—275
WHAG	Cincinnati, Ohio, University of Cincinnati	100—233
WHAM	Rochester, N. Y., University of Rochester	100—278
WHAR	Atlantic City, N. J., Seaside Hotel	100—275
WHAS	Louisville, Ky., Courier-Journal & Louisville Times	500—399.8
WHAV	Wilmington, Del., Wilmington Electrical Specialty Co.	100—266
WHAZ	Troy, N. Y., Rennselaer Polytechnic Institute	500—379.5
WHB	Kansas City, Mo., Sweeney School Co.	500—365.6
WHK	Cleveland, Ohio, Radiovox Co.	100—283
WHN	New York, N. Y., George Schubel	500—361.2
WHO	Des Moines, Iowa, Bankers Life Co.	500—526
WIAC	Galveston, Tex., Galveston Tribune	100—360
WIAD	Philadelphia, Pa., Howard R. Miller	100—254
WIAK	Omaha, Nebr., Journal-Stockman Co.	250—278
WIK	McKeesport, Pa., K. & L. Electric Co.	100—234
WIP	Philadelphia, Pa., Gimbel Brothers	500—508.2
WJAB	Lincoln, Nebr., American Electric Co.	100—229
WJAD	Waco, Tex., Jackson's Radio Engineering Laboratories	500—352.7
WJAG	Norfolk, Nebr., Norfolk Daily News	250—270
WJAK	Greentown, Ind., Clifford L. White	50—254
WJAM	Cedar Rapids, Iowa, D. M. Perham	20—268
WJAN	Peoria, Ill., Peoria Star	100—273
WJAR	Providence, R. I., The Outlet Co.	500—305.9
WJAS	Pittsburgh, Pa., Pittsburgh Radio Supply House	500—275
WJAX	Cleveland, Ohio, Union Trust Co.	500—390
WJAZ	Zenith Radio Corp., Chicago, Ill.	20—268
WJD	Granville, Ohio, Denison University	10—217.3
WJJD	Moosheart, Ill., Supreme Lodge, Loyal Order of Moose	500—302.8
WJY	New York, N. Y., R. C. A.	750—405.2
WJZ	New York, N. Y., R. C. A.	500—454.3
WKAA	Cedar Rapids, Iowa, H. F. Paar	50—278
WKAD	East Providence, R. I., Charles Looff (Crescent Park)	20—240
WKAF	Wichita Falls, Tex., W. S. Radio Supply Co.	100—360
WKAN	Montgomery, Ala., United Battery Service Co.	15—226
WKAP	Cranston, R. I., Dutee W. Flint	50—360
WKAQ	San Juan, P. R., Radio Corp. of Porto Rico	500—340.7
WKAR	East Lansing, Mich., Michigan Agricultural College	500—285.5
WKAY	Laconia, N. H., Laconia Radio Club	50—254
WKBF	Cranston, R. I., Dutee W. Flint	500—286
WKY	Oklahoma, Okla., WKY Radio Shop	100—360
WLAL	Tulsa, Okla., Naylor Electrical Co.	100—360
WLAP	Louisville, Ky., W. V. Jordan	20—286
WLAX	Greencastle, Ind., Greencastle Community Broadcasting Station	10—231
WLB	Minneapolis, Minn., University of Minnesota	5—278
WLBL	Stevens Point, Wis., Wisconsin Department of Markets	500—278
WLS	Chicago, Ill., Sears, Roebuck & Co.	500—344.6
WLW	Cincinnati, Ohio, Crosley Radio Corp.	1000—422.3
WMAC	Cazenovia, N. Y., Clive B. Meredith	100—275
WMAF	Dartmouth, Mass., Round Hills Radio Corp.	100—500—360
WMAH	Lincoln, Nebr., General Supply Co.	100—254
WMAK	Lockport, N. Y., Norton Laboratories	500—266
WMAN	Columbus, Ohio, First Baptist Church (W. E. Heskett)	50—278
WMAQ	Chicago, Ill., Chicago Daily News	500—447.5
WMAY	St. Louis, Mo., Kingshighway Presbyterian Church	100—280
WMAZ	Macon, Ga., Mercer University	100—261



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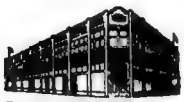

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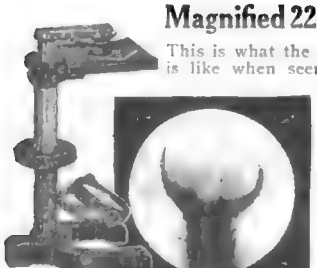

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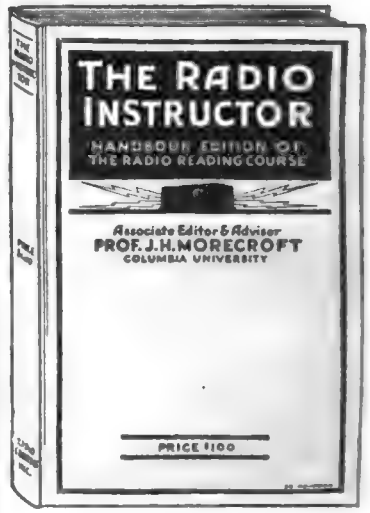
WMC	Memphis, Tenn., "Commercial Appeal"	500—499.7
WMH	Cincinnati, Ohio, Ainsworth-Gates Radio Co.	750—422.3
WMU	Washington, D. C., Doubleday-Hill Electric Co.	100—261
WNAC	Boston, Mass., Shepard Stores	100—280.2
WNAD	Norman, Okla., University of Oklahoma	100—254
WNAL	Omaha, Nebr., Omaha Central High School	20—258
WNAP	Springfield, Ohio, Wittenberg College	100—248
WNAR	Butler, Mo., First Christian Church	20—231
WNAT	Philadelphia, Pa., Lenning Brothers	100—250
WNAX	Yankton, S. Dak., Dakota Radio Apparatus Co.	100—244
WNJ	Newark, N. J., Radio Shop of Newark	100—233
WNYC	New York, N. Y., City of New York	1000—526
WOAC	Lima, Ohio, Page Organ Co.	50—266
WOAE	Fremont, Nebr., Midland College	15—280
WOAF	Tyler, Tex., Tyler Commercial College	10—360
WOAI	San Antonio, Tex., Southern Equipment Co.	500—394.5
WOAJ	Parsons, Kans., Ervins Electrical Co.	15—258
WOAN	Lawrenceburg, Tenn., James D. Vaughn	200—282.8
WOAR	Kenosha, Wis., Henry P. Lundskow	50—229
WOAV	Erie, Pa., Pennsylvania National Guard, 112th Infantry	50—242
WOAW	Omaha, Nebr., Woodmen of the World	500—526
WOAX	Trenton, N. J., Franklyn J. Wolff	500—240
WOC	Davenport, Iowa, Palmer School of Chiropractic	500—483.6
WOCL	Jamestown, N. Y., Hotel Jamestown	15—275
WOI	Ames, Iowa, Iowa State College	500—360
WOO	Philadelphia, Pa., John Wanamaker	500—508.2
WOQ	Kansas City, Mo., Unity School of Christianity	500—278
WOR	Newark, N. J., L. Bamberger & Co.	500—405.2
WORD	Batavia, Ill., Peoples Pulpit Associatoin	500—278
WOS	Jefferson City, Mo., Missouri State Marketing Bureau	500—440.9
WPAC	Okmulgee, Okla., Donaldson Radio Co.	100—360
WPAJ	New Haven, Conn., Doolittle Radio Corp.	100—268
WPAK	Agricultural College, N. Dak., North Dakota Agricultural College	50—275
WPAU	Moorehead, Minn., Concordia College	10—286
WPAZ	Charleston, W. Va., John R. Koch (Dr.)	10—268
WPG	Atlantic City, N. J., Municipality of Atlantic City	500—299.8
WPSC	State College, Penna., Pennsylvania State College	500—405
WQAA	Parkesburg, Pa., Horace A. Beale, Jr.	500—220
WQAC	Amarillo, Tex., Gish Radio Service	100—234
WQAE	Springfield, Vt., Moore Radio News Station	50—275
WQAM	Miami, Fla., Electrical Equipment Co.	100—268
WQAN	Scranton, Pa., Scranton Times	100—250
WQAO	New York, N. Y., Calvary Baptist Church	100—360
WQAQ	Abilene, Tex., West Texas Radio Co. (Abilene Daily Reporter)	100—360
WQAS	Lowell, Mass., Prince-Walter Co.	100—252
WQJ	Chicago, Ill., Calumet Rainbow Broadcasting Co.	500—447.5
WRAA	Houston, Tex., Rice Institute	100—256
WRAF	Laporte, Ind., The Radio Club	15—224
WRAL	St. Croix Falls, Wis., Northern States Power Co.	100—248
WRAM	Galesburg, Ill., Lombard College	100—244
WRAN	Waterloo, Iowa, Black Hawk Electrical Co.	10—236
WRAO	St. Louis, Mo., St. Louis Radio Service Co.	10—227
WRAV	Yellow Springs, Ohio, Antioch College	100—263
WRAW	Reading, Pa., Avenue Radio & Electric Shop	10—238
WRAX	Gloucester City, N. J., Flexon's Garage	100—268
WRBC	Valparaiso, Ind., Immanuel Lutheran Church	500—278
WRC	Washington, D. C., Radio Corp. of America	500—468.5
WREO	Lansing, Mich., Reo Motor Car Co.	500—285.5
WRHF	Washington, D. C., Washington Radio Hospital Fund	50—256
WRK	Hamilton, Ohio, Doron Bros. Electrical Co.	200—270



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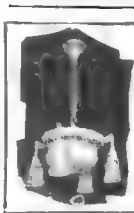

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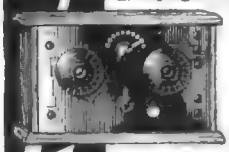

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WRW	Tarrytown, N. Y., Tarrytown Radio Research Laboratory	500—273
WSAC	Clemson College, S. C., Clemson Agricultural College	500—336.9
WSAD	Providence, R. I., J. A. Foster Co.	100—261
WSAI	Cincinnati, Ohio, United States Playing Card Co.	500—325.9
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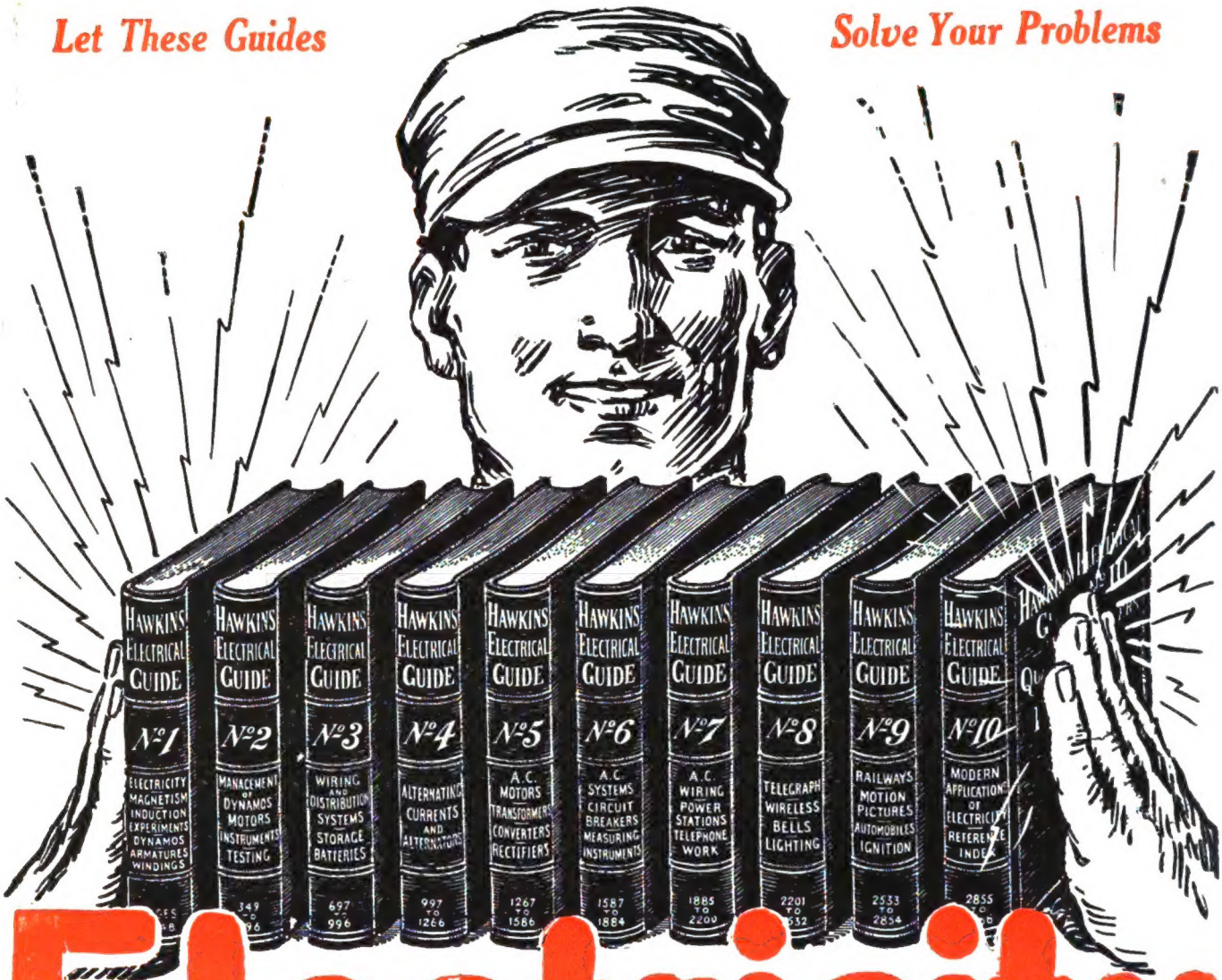

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